UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

OFFICE OF CHEMICAL SAFETY
AND POLLUTION PREVENTION

September 22, 2016

PC Code: 113501, 113502
DP Barcode: 433073, ~~424738~~

MEMORANDUM

SUBJECT: **Metalaxyl and Mefenoxam**: Preliminary Ecological Risk Assessment for Registration Review of Metalaxyl and Mefenoxam (Metalaxyl-M) and Proposed Crop Group Conversion for Oilseed Group 20.

FROM: Freeborn G. Jewett, M.S., Biologist
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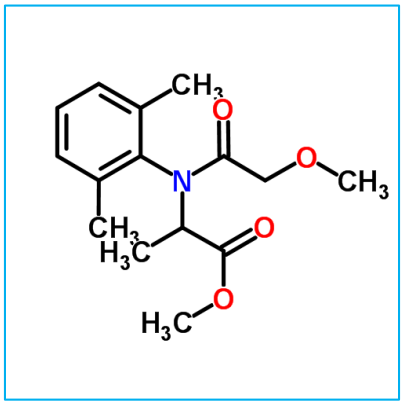
The Environmental Fate and Effects Division (EFED) has completed the preliminary environmental fate and ecological risk assessment (DP Barcode 433073) in support of the Registration Review of fungicides metalaxyl and mefenoxam [(also known as metalaxyl-M) (CAS Registry Number 79-57-2; PC Codes 113501 and 113502, respectively)] combined with the proposed crop group conversion for mefenoxam on oilseed crop group 20 (except cotton and sunflower) (DP Barcode 424738). All uses of metalaxyl pose a potential for adverse effects, *i.e.*, risk concerns, to listed and/or non-listed mammals, birds, reptiles, terrestrial-phase amphibians, terrestrial plants and estuarine/marine invertebrates. Currently labeled rates of mefenoxam pose a potential for adverse effects, *i.e.*, risk, to listed and non-listed mammals, birds, reptiles, terrestrial-phase amphibians, terrestrial plants, and aquatic vascular plants. The proposed crop group conversion for mefenoxam only poses potential risk to listed vascular aquatic plants.

Section 3.3 addresses ambiguous label language that could be revised to reduce conservative assumptions used in assessing potential risks. A lack of adequate application rates and intervals for many uses of metalaxyl and mefenoxam hindered the Agency's ability to carry out a comprehensive review of the environmental risks posed by use of metalaxyl and mefenoxam. **Appendix K** summarizes the use rates and highlights the use rates where label information is missing. In the absence of usage data, conservative assumptions were made.

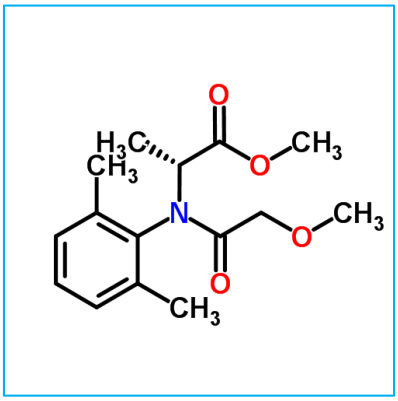
The proposed crop group conversion for mefenoxam applies to the product Apron XL (33.3% ai; EPA Reg# 100-791). This product is currently approved for use for damping off protection on canola as a seed treatment at a rate of 0.32 oz/100 lbs seed. The proposed change would expand the label from canola to the Oilseed Crop Group 20 (except sunflower and cotton) at the same application rate. An assessment of this seed treatment application rate will be carried out as part of this PRA.

Ecological Risk Assessment for the Registration Review of Metalaxyl and Mefenoxam

USEPA PC CODES 113501, 113502



Metalaxyl (CAS 57837-19-1)



Mefenoxam (CAS 706630-17-0)

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August 8, 2016

Table of Contents

1. Executive Summary

1.1. Overview

This Preliminary Risk Assessment (PRA) document (D424738) transmits the ecological risk assessment for the registration review of metalaxyl and mefenoxam, as well as an assessment for a proposed crop group conversion for mefenoxam on oilseed crop group 20 (except cotton and sunflower) (D424738).This PRA considers both chemicals because they are composed of the same enantiomers in different proportions. This document examines the risks to non-target organisms associated with its labeled uses. The risk assessment is based on the best available information on the use, environmental fate and transport, and effects of metalaxyl and mefenoxam on non-target organisms. Determinations for listed species are not considered at this time.

1.2. Metalaxyl and Mefenoxam Mode of Action and Usage Summary

Metalaxyl/mefenoxam are systemic phenylamide fungicides applied pre or post planting specifically to prevent or control oomycetes fungi, an economically important group of species that includes downy mildew and *Phytophthora infestans*, the cause in the great Irish potato blight of 1846, which resulted in one million starvation-related deaths. The mode of action is inhibition of RNA synthesis in affected fungi. Metalaxyl is a racemic mixture, comprised of approximately equal proportions (50:50) of the R and *S* enantiomers, whereas mefenoxam is an enrichment comprised almost solely of the R enantiomer. The R enantiomer may have more fungicidal activity than the *S* enantiomer.

Metalaxyl/mefenoxam are applied pre and post planting to both agricultural and non-agricultural sites as soil band, broadcast, chemigation, soil drench, or foliar spray treatments (using aerial or ground equipment). They are formulated as a dust, emulsifiable concentrate, flowable concentrate, liquid-ready to use, water dispersible granule, or wettable powder formulation for seed treatments. According to a screening level usage analysis (SLUA) of national agricultural pesticide usage data (2004 – 2013) by the Agency's Biological and Economic Analysis Division (BEAD) (USEPA 2015a), an annual average of 108,500 lb ai metalaxyl was applied to agricultural sites in the United States. Of this, about 65% of the total usage was soybean seed treatment (70,000 lb ai), and 10% was wheat seed treatment (10,000 lb ai) (USEPA 2015a). Since 1992, mefenoxam has been registered for similar use sites, replacing some of the usage of metalaxyl. An annual average of 309,000 lb ai mefenoxam was applied to agricultural sites in the United States. Of this, about 13% of the total usage was on potatoes and soybean seed treatment (40,000 lb ai each), 9.7% was on oranges, tobacco and tomatoes (30,000 lb ai each) and 2.9% was wheat seed treatment (9,000 lb ai) (USEPA 2015b).

The application rates for metalaxyl/mefenoxam on various crops are summarized by BEAD (**Appendix K, Table 3.1-3.2**). The use and usage information provided on labels is incomplete. Application information for many registered uses, such as the maximum number of applications per year, the maximum annual application rate and the minimum retreatment interval, is not specified (NS) in the use information tables and appendix below**.** The Agency is assessing use patterns from the label with complete application information, assuming they are representative of use across the labels. To the extent that use exceeds these assumptions, this assessment may

under-predict exposure. **If the labels with incomplete application information are not made consistent with the labels with complete information, then further exposure assessment may be needed.**

1.3. Predominant Risk Concerns

Existing uses

This assessment concludes that the use of metalaxyl and mefenoxam in accordance with registered labels may result in adverse effects to listed and non-listed mammals, birds, reptiles, terrestrial-phase amphibians, terrestrial plants, estuarine/marine invertebrates and aquatic vascular plants. **Table 1.1** summarizes the risk concerns for registered uses of metalaxyl and mefenoxam.

Table 1.1. Risk Concerns to Taxonomic Groups from Current Uses of Metalaxyl and Mefenoxam.

Use Sites	Fish and aquatic amphibians			Aquatic invertebrates			Aquatic plants		Birds, reptiles, and terrestrial amphibians			Mammals			Terrestrial invert[1]	Terrestrial plants	
	Nonlisted acute	Listed acute	Chronic	Nonlisted acute	Listed acute	Chronic	Nonlisted	Listed	Nonlisted acute	Listed acute	Chronic	Nonlisted acute	Listed	Chronic	Acute Contact	Nonlsited	Listed
Metalaxyl																	
Seed Treatment																	
Ornamental grasses	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No
Flax	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No
Cucumber, Mustard, Okra, Clary Sage, Beets (Unspecified), Onions (Green)	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No
Brassica (Cole) Leafy Vegetables	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No
Barley, Beans, Beans, Dried-Type, Beans, Succulent (Lima), Beans, Succulent (Snap), Beets (Greens),Brassica (Head And Stem) Vegetables, Buckwheat, Canola\Rape, Carrot (Including Tops), Cereal Grains, Clover, Cole Crops, Clover, Cole Crops, Corn, (Pop, Sweet, Silage, Filed), Cotton, Cowpea, Blackeyed Pea, Sitao Cowpea, Cucurbit Vegetables, Dill, Fruiting Vegetables, Garbanzos (Including Chick Peas), Golf Course Turf, Grass Forage/Fodder/Hay, Leafy Vegetables, Lentils,	No	No	No	No	No	No	No	No	No	**Yes**	No	No	No	No	No	No	No

Use Sites	Fish and aquatic amphibians			Aquatic invertebrates			Aquatic plants		Birds, reptiles, and terrestrial amphibians			Mammals			Terrestrial invert[1]	Terrestrial plants	
	Nonlisted acute	Listed acute	Chronic	Nonlisted acute	Listed acute	Chronic	Nonlisted	Listed	Nonlisted acute	Listed acute	Chronic	Nonlisted acute	Listed	Chronic	Acute Contact	Nonlsited	Listed
Lespedeza, Lupine(Grain), Oats , Nongrass Forage/Fodder/Straw/Hay, Oats, Onion, Ornamental And/Or Shade Trees, Ornamental Lawns And Turf, Peanuts, Peas, Residential Lawns, Rice, Root And Tuber Vegetables, Rye, Small Grains, Small Seeded Legumes, Soybeans, Spinach, Sugar Beet, Trefoil, Triticale, Vetch, Wheat																	
Corn (Sweet), Golf Course Turf, Ornamental Lawns And Turf, Peas, Residential Lawns, Sunflower,	No	No	No	No	No	No	No	No	No	**Yes**	No	No	No	No	No	No	No
Corn (Unspecified), Sorghum	No	No	No	No	No	No	No	No	No	**Yes**	**Yes**	No	**Yes**	**Yes**	No	No	No
Proso Millet	No	No	No	No	No	No	No	No	No	**Yes**	**Yes**	No	**Yes**	**Yes**	No	No	No
Aerial/Ground Application																	
Hops	No	No	No	No	No	No	No	No	No	**Yes**	No	No	**Yes**	**Yes**	No	No	No
Fruiting Vegetables, Strawberry	No	No	No	No	No	No	No	No	**Yes**	**Yes**	No	No	**Yes**	**Yes**	No	No	No
Cranberry (Dry Harvested)	No	No	No	No	No	No	No	No	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	No	No	No
Cranberry (Wet Harvested)	No	No	No	No	**Yes**	**Yes**	No	No	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	No	No	No
Cole Crops, Cucurbit Vegetables, Leafy Vegetables, Lettuce	No	No	No	No	No	No	No	No	**Yes**	**Yes**	No	No	**Yes**	**Yes**	No	No	**Yes**
Eggplant, Pepper, Tomato	No	No	No	No	No	No	No	No	**Yes**	**Yes**	No	**Yes**	**Yes**	**Yes**	No	No	**Yes**
Golf Course Turf, Ornamental Lawns And	No	No	No	No	No	No	No	No	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	No	No	**Yes**

Use Sites	Fish and aquatic amphibians			Aquatic invertebrates			Aquatic plants		Birds, reptiles, and terrestrial amphibians			Mammals			Terrestrial invert[1]	Terrestrial plants	
	Nonlisted acute	Listed acute	Chronic	Nonlisted acute	Listed acute	Chronic	Nonlisted	Listed	Nonlisted acute	Listed acute	Chronic	Nonlisted acute	Listed	Chronic	Acute Contact	Nonlsited	Listed
Turf, Ornamental Sod Farm (Turf), Recreation Area Lawns																	
Papaya	No	No	No	No	No	No	No	No	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	No	**Yes**	**Yes**
Citrus (Trees)	No	No	No	No	No	**Yes**[2]	No	No	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	No	**Yes**	**Yes**
Avocado, Deciduous Fruit Trees (Unspecified), Stone Fruits, Tree Nuts						**Yes**[2]											
Citrus (Nursery stock)	No	No	No	No	No	**Yes**[2]	No	No	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	No	**Yes**	**Yes**
Mefenoxam																	
Seed Treatment																	
Barley, triticale, wheat	No	No	No	No	No	No	No	**Yes**	No	No	No	No	No	No	No	No	No
Oilseed Group 20*	**No**	**No**	**No**	**No**	**No**	**No**	**No**	**Yes**	**No**	**No**	**No**	**No**	**No**	**No**	**No**	**No**	**No**
Corn (sweet)	No	No	No	No	No	No	No	**Yes**	No	No	No	No	No	No	No	No	No
Cotton	No	No	No	No	No	No	No	**Yes**	No	No	No	No	No	No	No	No	No
Legumes	No	No	No	No	No	No	No	**Yes**	No	No	No	No	No	No	No	No	No
Soybeans	No	No	No	No	No	No	No	**Yes**	No	No	No	No	No	No	No	No	No
Foliar/Spray Application																	
Broccoli, Chinese Broccoli, Brussels Sprouts, Cabbage, Chinese Cabbage, Cauliflower	No	No	No	No	No	No	No	**Yes**	No	No	No	No	No	No	No	No	No
Bulb Vegetables	No	No	No	No	No	No	No	**Yes**	No	No	No	No	No	No	No	No	No
Beans (succulent, snap), Caneberries	No	No	No	No	No	No	No	**Yes**	No	No	No	No	No	No	No	No	No
Garlic	No	No	No	No	No	No	No	**Yes**	No	**Yes**	No	No	No	No	No	No	No
Pepper, Radish	No	No	No	No	No	No	No	**Yes**	No	**Yes**	No	No	No	No	No	No	No
Potato	No	No	No	No	No	No	No	**Yes**	No	No	No	No	No	No	No	No	No
Leek, Shallot	No	No	No	No	No	No	No	**Yes**	No	**Yes**	No	No	No	No	No	No	No
Melons, Pumpkin, Squash, Cucumber	No	No	No	No	No	No	No	**Yes**	No	**Yes**	No	No	No	No	No	No	No
Hops	No	No	No	No	No	No	No	**Yes**	No	**Yes**	No	No	No	No	No	No	No

Use Sites	Fish and aquatic amphibians			Aquatic invertebrates			Aquatic plants		Birds, reptiles, and terrestrial amphibians			Mammals			Terrestrial invert[1]	Terrestrial plants	
	Nonlisted acute	Listed acute	Chronic	Nonlisted acute	Listed acute	Chronic	Nonlisted	Listed	Nonlisted acute	Listed acute	Chronic	Nonlisted acute	Listed	Chronic	Acute Contact	Nonlsited	Listed
Kiwi	No	No	No	No	No	No	No	**Yes**	No	**Yes**	No	No	No	**Yes**	No	No	No
Ginseng	No	No	No	No	No	No	No	**Yes**	No	**Yes**	No	No	No	**Yes**	No	No	No
Legume Vegetables	No	No	No	No	No	No	No	**Yes**	No	**Yes**	No	No	No	No	No	No	No
Fruiting Vegetables Strawberry	No	No	No	No	No	No	No	**Yes**	**Yes**	**Yes**	No	No	**Yes**	**Yes**	No	No	No
Turf	No	No	No	No	No	No	No	**Yes**	**Yes**	**Yes**	No	No	**Yes**	**Yes**	No	No	No
Cranberry (Dry Harvested)	No	No	No	No	No	No	No	**Yes**	**Yes**	**Yes**	No	No	**Yes**	**Yes**	No	No	No
Cranberry (Wet Harvested)	No	No	No	No	**Yes**[2]	No	No	**Yes**	**Yes**	**Yes**	No	No	**Yes**	**Yes**	No	No	No
Carrots, Cucurbit Vegetables, Leafy Vegetables, Cole Crops, Spinach	No	No	No	No	No	No	No	**Yes**	No	**Yes**	No	No	**Yes**	**Yes**	No	No	No
Herbs, Tomato	No	No	No	No	No	No	No	**Yes**	**Yes**	**Yes**	No	No	**Yes**	**Yes**	No	No	No
Subtropical fruit	No	No	No	No	No	No	No	**Yes**	**Yes**	**Yes**	No	No	**Yes**	**Yes**	No	No	No
Tobacco	No	No	No	No	No	No	No	**Yes**	**Yes**	**Yes**	No	No	**Yes**	**Yes**	No	No	No
Blueberry, Bush Berries, Raspberry	No	No	No	No	No	No	No	**Yes**	**Yes**	**Yes**	No	No	**Yes**	**Yes**	No	No	**Yes**
Orchards (Unspecified), Stone Fruits, Tree Nuts, Avocado	No	No	No	No	No	No	No	**Yes**	**Yes**	**Yes**	No	No	**Yes**	**Yes**	No	No	**Yes**
Citrus	No	No	No	No	No	No	No	**Yes**	**Yes**	**Yes**	No	No	**Yes**	**Yes**	No	No	**Yes**
Deciduous Fruit Trees (Unspecified)	No	No	No	No	No	No	No	**Yes**	**Yes**	**Yes**	No	No	**Yes**	**Yes**	No	No	**Yes**

*Use is a Proposed Crop Group Conversion to oilseed crop group 20, which includes Borage, Calendula, Canola, Castor oil plant, Chinese tallowtree, Crambe, Cuphea, Echium, Euphorbia, Evening primrose, Flax seed, Gold of pleasure, Hare's ear mustard, Jojoba, Lesquerella, Lunaria, Meadowfoam, Milkweed, Mustard seed, Niger seed, Oil radish, Poppy seed, Rapeseed (including canola), Safflower, Sesame, Stokes aster, Sweet rocket, Tallowwood, Tea oil plant, Vernonia.

[1]Risks to larval honeybees from acute and chronic exposure, as well as risk to adult honeybees from oral exposure remains uncertain because relevant data have not been submitted for this taxa. As a result, there is uncertainty related to the risk picture for honeybees.

[2]Risks for estuarine/marine species

Mammals- Acute and chronic risks to mammals from seed treatment and foliar spray application of metalaxyl were identified. Acute and chronic risk concerns for mammals were identified only for foliar/ground application of mefenoxam. While the risk calculations result in RQs that exceed chronic thresholds, the available toxicity data cannot establish the potential for higher doses to elicit chronic effects. Therefore, the potential for these pesticides to elicit adverse chronic effects at any dose higher than the reported NOAEC has not been established and the magnitude of the RQs in terms of potential actual chronic effects is highly uncertain

Birds, Reptiles and Terrestrial-Phase Amphibians- Acute risk concerns to birds were identified for the highest seed treatment rates and all foliar/ground spray application rates of metalaxyl. These risks to listed and/or non-listed species were identified for all body sizes (small, medium and large) of herbivorous, omnivorous and insectivorous birds. Acute risk concerns to listed and/or non-listed birds from mefenoxam uses were identified for small and medium birds from foliar/ground application only, while listed species risk concerns were identified for all body sizes of birds. Chronic risks to birds were identified only for metalaxyl, at all body sizes and feeding types. The likelihood of triggering a risk concern was roughly proportional to the application rate, where the lower application rates did not trigger as many risk concerns as the higher application rates. Similarly, application rates with a longer application interval (90 days vs 7 days) resulted in lower EECs and resulting RQs. Terrestrial modeling was done under the assumption of a 35 day foliar half-life. A shorter estimated half-life value may alter risk conclusions, and based on the slow degradation of metalaxyl and mefenoxam, 35 days is likely to be a conservative assumption.

Terrestrial Invertebrates: No risk concerns were identified for honeybees based on contact exposure. Risk from dietary exposure is unknown. As metalaxyl and mefenoxam are systemic (potential for accumulating in pollen/nectar) and registered uses include pollinator attractive crops (potential for exposure), additional data on adult and larval bees oral/dietary exposure toxicity will address the uncertainty related to terrestrial invertebrate risk.

Terrestrial Plants: Risk concerns for monocots and dicots were identified based on foliar/ground spray uses for metalaxyl, while risk concerns for mefenoxam based on folar/ground spray application are limited to monocot plants.

Freshwater and Estuarine/Marine Fish- No risk concerns exist for freshwater or estuarine/marine fish based on runoff. Risk concerns for listed freshwater fish were identified based on acute exposure to spray drift deposition of the formulated product Ridomil 2E-G. Aquatic EECs and risk estimates are presented for maximum labeled rates only.

Freshwater and Estuarine/Marine Invertebrates- Chronic risk concerns for estuarine/marine invertebrates were identified for metalaxyl use on citrus (trees and nursery stock) and deciduous fruit trees. In addition, acute and chronic risk concerns exist for freshwater and estuarine/marine invertebrates for metalaxyl for use on cranberry where exposure results from direct application of metalaxyl to surface water (flooded bogs). These risk exceedances are based on concentrations in undiluted cranberry bog water at a depth of 12 inches, with degradation assumed to occur under both dry (pre flood) and flooded conditions. In addition to non-target organisms that reside

in cranberry bogs, these risks are conservatively assumed to reflect risks to organisms that reside in receiving waters near points where cranberry bogs actively discharge to such waters. Exposure to metalaxyl/mefenoxam to rainfall-runoff transport of residues from bogs in a pre-flood state are assessed using standard EFED surface water modeling tools. Chronic risk concerns to estuarine marine invertebrates were identified for the highest use rates of metalaxyl, but not for mefenoxam. Risk concerns for listed estuarine/marine invertebrates were identified based on acute exposure to spray drift deposition of the formulated product Ridomil 2E-G, which is not currently registered. Aquatic EECs and risk estimates are presented for maximum labeled rates only.

Aquatic Plants- No risk concerns exist for non-listed vascular or listed or non-listed non-vascular aquatic plants based on existing or proposed use rates. Due to data uncertainties discussed below, risk to listed vascular aquatic plants from uses on mefenoxam could not be precluded.

Due to incomplete use information, risk conclusions for the highest application rate for metalaxyl on citrus are equal to alfalfa, almond, apple, blueberry, asparagus, clover, ginseng, grass forage/fodder/hay, legume vegetables, onion, ornamental and/or shade trees, ornamental herbaceous plants, ornamental nonflowering plants, ornamental woody shrubs and vines, ornamentals (unspecified), peanuts, pineapple, potato, white/Irish (or unspecified), soybeans (unspecified), sugar beet, tobacco, and trefoil.

Due to incomplete use information for use of mefenoxam on alfalfa, apple, artichoke, asparagus, clover, conifers (plantations/nurseries), cotton, grass forage/fodder/hay, onion (bulb and green), peanuts, pineapple, soybeans, sugar beet, lettuce, and ornamentals (unspecified), risk conclusions from the highest application rate (citrus) are assumed for these uses.

Proposed Crop Group Conversion

This assessment did not identify risk concerns to terrestrial or aquatic taxa (except listed, vascular aquatic plants) based on the proposed crop group conversion. Based on data uncertainties discussed in this document, risk to listed, vascular, aquatic plants could not be precluded. These results are consistent with the results of the previous assessment for canola, which assessed the same seed treatment application rate, although EFED has since updated the seed treatment assessment methodology.

Major Uncertainties and Data Needed to Clarify Uncertainties

The following major uncertainties have been identified:

- This risk assessment employs a bridging strategy for the environmental fate and transport properties of mefenoxam and metalaxyl, where fate data for metalaxyl are used to characterize fate properties of mefenoxam.
- Application information for many uses is incomplete. **Appendix K** summarizes the missing label information. As a result, some uses could not be assessed. Where possible,

label information such as annual application rate or maximum number of applications was inferred based on available label data. In this assessment, EFED made every effort to capture the highest application rates, but if the inferred information does not reflect actual use patterns, this assessment may underestimate exposure. Some of the incomplete use information applies to pollinator-attractive crops such as alfalfa and almonds. As a result, this missing information may impact the accuracy of pollinator assessment.

The following data needs have been identified in this assessment:
Based on the new Pollinator Risk Assessment Framework[1] (USEPA 2014), released after the publication of the Problem Formulation, there are uncertainties with respect to the toxicity of metalaxyl and mefenoxam to honeybees. Metalaxyl and mefenoxam are systemic compounds, and according to USDA's pollinator attractiveness index, these chemicals are registered for many pollinator attractive crop species (USDA, 2014).The studies listed below are recommended for submissions and would significantly reduce uncertainty in an attempt to adequately assess the risks to pollinators. Additional studies (higher tiered semi-field/field) may be required for refinements if results of the studies below indicate significant risks to bees.

- OECD 213- Honeybee Acute Oral Toxicity- TGAI
- Non-Guideline Tier I-Honeybee Adult Chronic Oral Exposure- TGAI
- Non-Guideline Tier I- Honeybee Larval Acute and Chronic Oral Exposure- TGAI
- Non-Guideline Tier II- Nectar and Pollen Residue Study for Insect Pollinators*-TEP
- Non-Guideline (OECD 75) Tier II- Semi-Field Testing for Honeybees*- TEP
- 850.3040 Tier III- Field Testing for Pollinators*-TEP

*Conditionally required based on the results of Tier I and II testing.

2. Introduction

This preliminary risk assessment (PRA) examines the potential ecological risks associated with currently labeled uses of the fungicides metalaxyl and mefenoxam, as well as a proposed crop group conversion for a seed treatment use on canola to include oilseed crop group 20 (except cotton and sunflower; includes borage, calendula, canola, castor oil plant, chinese tallowtree, crambe, cuphea, echium, euphorbia, evening primrose, flax seed, gold of pleasure, hare's ear mustard, jojoba, lesquerella, lunaria, meadowfoam, milkweed, mustard seed, niger seed, oil radish, poppy seed, rapeseed (including canola), safflower, sesame, stokes aster, sweet rocket, tallowwood, tea oil plant, vernonia.) at the same existing application rate based on the best available scientific and commercial information on the use, environmental fate and transport, and effects of metalaxyl and mefenoxam on non-target organisms. The risk assessment methodology is described in the *Overview of the Ecological Risk Assessment Process in the Office of Pesticide Programs* ("Overview Document") (USEPA, 2004).

Metalaxyl and mefenoxam are being assessed together in registration review because they are composed of the same enantiomers (i.e. optical isomers) in different proportions. Metalaxyl is a racemic mixture that composed of approximately equal proportions of the R and S enantiomers, whereas mefenoxam, (or metalaxyl-M) is an enrichment comprised almost exclusively of the S

[1] http://www.epa.gov/pollinator-protection/pollinator-risk-assessment-guidance

enantiomer. The R enantiomer may have more fungicidal activity than the *S* enantiomer, however toxicity of the purified R enantiomer may not be greater to non-target species. The assessment bridges the fate data between metalaxyl and mefenoxam, as environmental fate data are only available for metalaxyl. From an effects perspective, the two chemicals are assessed separately where possible, as differences in toxicity are observed and data are available for each chemical. This assessment, conducted as part of the Registration Review, builds on the preliminary problem formulation for mefenoxam/metalaxyl that was completed in 2010 (USEPA, 2010). In addition, both open literature and studies submitted by the technical registrants in response to data requirements further inform this risk assessment. This document therefore provides a synthesis of the environmental fate and ecotoxicity information to evaluate potential risk to non-target terrestrial and aquatic plants and animals.

3. Problem Formulation Update

Since the publication of the Problem Formulation (USEPA, 2010a), two assessments have been carried out for mefenoxam.

- Ecological Risk Assessment for mefenoxam for snap beans, caneberries (crop group 13-07A), Spinach bushberries (crop group 13-07B), bulb onions (subgroup 3-07A), green onions (subgroup 3-07B) (USEPA 2010b)
    - This assessment determined that risk concerns exist to birds and mammals, from the proposed uses. Due to a lack of data, risk to aquatic plants, terrestrial plants and terrestrial invertebrates could not be evaluated and therefore were presumed as a result of a lack of data.
- Ecological Risk Assessment to Support the Proposed Section 3 New Use of Mefenoxam (Metalaxyl-M) on Oilseed Crop Group 20 (except cotton and sunflower) (USEPA, 2015).
    - Use of mefenoxam as a seed treatment on canola was previously assessed (USEPA, 2001; D254867) at a rate of 0.00075 lbs ai/A with an assumed seeding rate of 10 lbs/A. The proposed application rate for Apron XL on Oilseed Crop Group 20 (which includes borage, calendula, canola, castor oil plant, chinese tallowtree, crambe, cuphea, echium, euphorbia, evening primrose, flax seed, gold of pleasure, hare's ear mustard, jojoba, lesquerella, lunaria, meadowfoam, milkweed, mustard seed, niger seed, oil radish, poppy seed, rapeseed (including canola), safflower, sesame, stokes aster, sweet rocket, tallowwood, tea oil plant, vernonia) is the same, at 0.00075 lb ai/A. The 2001 (revised) canola assessment did not identify risks to terrestrial or aquatic animals from the proposed seed treatment use on canola. A full risk assessment for this crop group conversion was not conducted. A full risk assessment for this proposed action will be conducted as part of this assessment in support of the proposed crop group conversion.

No endangered species assessments have been carried out on mefenoxam or metalaxyl.

Since these assessments were conducted, EFED received toxicity studies for chronic and acute toxicity to aquatic and terrestrial organisms in response to a Data Call-In (DCI) issued at the time of the problem formulation, the following studies were received and reviewed for metalaxyl following the publication of the Problem Formulation:

- Chronic avian toxicity with a bobwhite quail (TGAI 98.4% ai; MRID 49115801; Supplemental- quantitative)
- Chronic avian toxicity with a mallard duck (TGAI 98.4% ai; MRID 49115901; Acceptable)
- Acute toxicity test with a canary (TGAI 98.4% ai; MRID 49311101; Acceptable)
- Chronic toxicity test with a mysid shrimp (TGAI 98.4% ai; MRID 49116001; Acceptable)
- Acute toxicity test with the eastern oyster (TGAI 98.4% ai; MRID 49145101; Acceptable)
- Toxicity test with green algae (Metalaxyl TGAI; MRID 49024012; Acceptable)
- Terrestrial plant toxicity test: Seedling emergence (Metalaxyl TEP; MRID 49024016; Acceptable)
- Terrestrial plant toxicity test: Vegetative vigor (Metalaxyl TEP; MRID 49024015; Acceptable)

The following studies were received and reviewed for mefenoxam:

- Acute toxicity test with the eastern oyster (TEP 45.3% ai; MRID 49049801; Supplemental)
- Acute toxicity test with the mysid shrimp (TEP 45.3% ai; MRID 49049802; Acceptable)
- Chronic toxicity test with the mysid shrimp (TGAI 97.8% ai; MRID 49156002; Acceptable)
- Acute toxicity test with *Daphnia magna* (TGAI 95.2% ai; MRID 49156001; Acceptable)
- Acute toxicity test with the fathead minnow (TGAI 97.3% ai; MRID 49049803; Acceptable)
- Acute toxicity test with the sheepshead minnow (TEP 45.3% ai; MRID 49049804; Acceptable)
- Acute toxicity test with the sheepshead minnow (TEP 97.3% ai; MRID 49049805; Acceptable)
- Acute toxicity test with the bluegill sunfish (TEP 45.3% ai; MRID 49049806; Acceptable)
- Terrestrial plant toxicity test: Seedling emergence (TEP 45.3% ai; MRID 49049807)
- Terrestrial plant toxicity test: Vegetative vigor (TEP 45.3% ai; MRID 49049808; Supplemental)
- Toxicity test with the freshwater diatom (TGAI 97.3% ai; MRID 49049809; Acceptable)
- Toxicity test with the blue-green algae (TGAI 97.3% ai; MRID 49049810; Acceptable)

In addition, the following studies have been submitted to the Agency and are currently under review. Preliminary evaluation of these data indicate that the endpoints reported in these studies are less sensitive than existing endpoints, so there is a low potential for the results of these studies to change risk conclusions. As a result, these studies will be reviewed after the completion of this assessment:

- Acute toxicity test with the bluegill sunfish (mefenoxam TEP; MRID 49024001)
- Acute toxicity test with the fathead minnow (metalaxyl TGAI; MRID 49024002)
- Acute toxicity test with the sheepshead minnow (metalaxyl TGAI; MRID 49024003)
- Acute toxicity test with *Daphnia magna* (metalaxyl TEP; MRID 49024004)
- Toxicity test with the blue-green algae (metalaxyl TGAI; MRID 49024005)
- Acute toxicity test with the rainbow trout (metalaxyl TGAI; MRID 49024006)
- Toxicity test with the freshwater diatom (metalaxyl TGAI; MRID 49024007)
- Toxicity test with the estuarine/marine diatom (metalaxyl TGAI; MRID 49024008)

- Toxicity test with duckweed (metalaxyl TGAI; MRID 49024009)
- Acute toxicity test with the mysid shrimp (metalaxyl TEP; MRID 49024010)
- Acute toxicity test with the sheepshead minnow (metalaxyl TEP; MRID 49024011)

Since the publication of the problem formulation, EFED developed exposure pathway screening models for inhalation and drinking water which address the potential relevance of these exposure pathways to birds and mammals. The Screening Tool for Inhalation Risk (STIR[2]; version 1.0) and Screening Imbibition Program (SIP[3]; version 1.0) evaluate inhalation and exposure through drinking water alone, respectively, as potential pathways of exposure[4]. These tools routes of exposure were not explored during the problem formulation phase of the assessment. In addition, a new guidance for assessing risk of pesticide treated seeds was released following publication of the problem formulation (USEPA, 2016a).

The following is a list of changes for environmental fate modeling:

- Used the latest PRZM/VVWM graphical user interface, the pesticide water calculator (PWC ver. 1.52);
- Recalculated half-lives of the ROCs using PestDF (ver. 3.1.2), which implements the NAFTA-harmonized kinetics guidance, based on the most recent data submitted by the registrant, including analysis of the impact of unextracted residues on aerobic soil metabolism half-lives;
- Used the default aerial spray drift model input of 12.5% rather than 5%, which is based on updated guidance (USEPA 2013).

3.1. Chemical Identification, Target Pests, and Mode of Action

Metalaxyl (PC Code 113501) and mefenoxam (PC Code 113502) are systemic phenylamide fungicides with a mode of action that is specific to controlling parasitic oomycetes "fungi." Oomycetes, or egg fungi, were once considered a group of fungi but have since been reassigned to the super-phylum Heterokonta, a diverse group of eukaryotes that includes diatoms and giant kelp (Kamoun, 2003). Pathogenic oomycetes are some of the most devastating pathogens of dicotyledonous plants and include foliar afflictions such as late potato blight (cause of the great Irish potato famine) and downy mildew, as well as soil borne varieties such as *Phytophthora* (Cohen and Coffey, 1986). The mode of action in these "fungi" is inhibition of RNA synthesis. Metalaxyl is a racemic mixture of the R and *S* enantiomers, whereas mefenoxam is a purification of the R enantiomer. The R enantiomer may have more fungicidal activity than the *S* enantiomer, however toxicity of the purified R enantiomer may not be greater to non-target species.

3.2. Use Characterization

[2] USEPA. 2014. Pesticides: Science and Policy. Terrestrial Models. STIR Version 1.0 (Screening Tool for Inhalation Risk). http://www2.epa.gov/pesticide-science-and-assessing-pesticide-risks/models-pesticide-risk-assessment#STIR

[3] USEPA. 2014. Pesticides: Science and Policy. Terrestrial Models. SIP Version 1.0 (Screening Imbibition Program). http://www2.epa.gov/pesticide-science-and-assessing-pesticide-risks/models-pesticide-risk-assessment#SIP

Table 3.1 and **3.2** summarize the label use information of metalaxyl and mefenoxam that are assessed in this document. Due to missing label information, all uses could not be assessed, but every effort was made to ensure that the highest overall application rates were captured. **Appendix K** summarizes uses and shows which uses are missing application information. Registered application methods include: seed treatments, foliar spray (ground and aerial methods), soil drench, and chemigation. There are numerous formulated products registered which contain metalaxyl or mefenoxam alone or as part of a co-formulation with other products such as imidacloprid and thiamethoxam. Registered formulated products for metalaxyl include Metstar 2E (Reg# 71532-5), Apron TL (Reg# 2935-458), and Vireo WDG (Reg # 70506-289). End-Use products with mefenoxam include Ridomil Gold (Reg # 100-1202), Ridomil Gold SL (Reg# 100-1202), Hurricane WDG (Reg# 100-1393), and Mefenoxam 2E (Reg# 100-1145).

Included in this PRA is an assessment of a proposed crop group expansion for mefenoxam. Apron XL (33.3% ai; EPA Reg# 100-791), a flowable concentrate containing 3 lbs ai/gallon, is currently approved for use for damping off protection on canola as a seed treatment at a rate of 0.32 oz/100 lbs seed. The proposed change would expand the label from canola to the Oilseed Crop Group 20 (except sunflower and cotton; includes borage, calendula, canola, castor oil plant, chinese tallowtree, crambe, cuphea, echium, euphorbia, evening primrose, flax seed, gold of pleasure, hare's ear mustard, jojoba, lesquerella, lunaria, meadowfoam, milkweed, mustard seed, niger seed, oil radish, poppy seed, rapeseed (including canola), safflower, sesame, stokes aster, sweet rocket, tallowwood, tea oil plant, vernonia) at the same application rate of 0.00075 lbs ai/A (0.32 oz/CWT) (D424738). An assessment of this seed treatment application rate will be carried out as part of this assessment.

Table 3.1. Use Patterns of Metalaxyl Included in this Assessment Based on Uses with Adequate Label Information.

Uses	Maximum rate / single application	Formulated Product Application Rate (fl oz/ CWT)[1]	% ai [1]	Maximum rate /year (lbs ai./A)	Application type
Seed Treatments					
Ornamental Grasses	0.00002 lbs/lb seed	3.4	0.82	NA	ST
Flax	0.00004 lbs/lb seed	4.6	1.26	NA	ST
Cucumber, Mustard, Okra, Clary Sage, Beets (Unspecified), Onions (Green)	0.0001 lbs/lb seed	0.75	28.4	NA	ST
Brassica (Cole) Leafy Vegetables	0.0002 lbs/lb seed	0.75	30.1	NA	ST
Barley, Beans, Beans, Dried-Type, Beans, Succulent (Lima), Beans, Succulent (Snap), Beets (Greens),Brassica (Head And Stem) Vegetables, Buckwheat, Canola\Rape, Carrot (Including Tops), Cereal Grains, Clover, Cole Crops, Clover, Cole Crops, Corn, (Pop, Sweet, Silage, Filed), Cotton, Cowpea, Blackeyed Pea, Sitao Cowpea, Cucurbit Vegetables, Dill, Fruiting Vegetables, Garbanzos	0.0003 lbs/lb seed	4.0	11.5	NA	ST

Uses	Maximum rate / single application	Formulated Product Application Rate (fl oz/ CWT)[1]	% ai [1]	Maximum rate /year (lbs ai./A)	Application type
(Including Chick Peas), Golf Course Turf, Grass Forage/Fodder/Hay, Leafy Vegetables, Lentils, Lespedeza, Lupine(Grain), Oats , Nongrass Forage/Fodder/Straw/Hay, Oats, Onion, Ornamental And/Or Shade Trees, Ornamental Lawns And Turf, Peanuts, Peas, Residential Lawns, Rice, Root And Tuber Vegetables, Rye, Small Grains, Small Seeded Legumes, Soybeans, Spinach, Sugar Beet, Trefoil, Triticale, Vetch, Wheat					
Corn, Sweet, Golf Course Turf, Ornamental Lawns And Turf, Peas, Residential Lawns, Sunflower,	0.0006 lbs/lb seed	8.0	11.5	NA	ST
Peas	0.0008 lbs/lb seed	9.5	11.5	NA	ST
Corn (Unspecified), Sorghum	0.0011 lbs/lb seed	14.1	11.5	NA	ST
Proso Millet	0.0014 lbs/lb seed	17.8	11.5	NA	ST
Uses	**Maximum rate / single application (lbs ai./A)**	**Maximum Number of applications / year**	**Minimum Retreatment Interval (days)**	**Maximum rate /year (lbs ai./A)**	**Application type**
Foliar Applications					
Hops	0.5	3	(14)[2]	(1.5)	G, B, SB
Fruiting Vegetables, Strawberry	1	(3)	17	3.04	A, G, SB,
Cranberry	1.8	3 CC[3]	(14)	5.4	G, B
Cole Crops, Cucurbit Vegetables, Leafy Vegetables, Lettuce	2	1	(14)	2	G,B
Eggplant, Pepper, Tomato	2	(2)	17	3	A, G, SB
Root And Tuber Vegetables	2	(1)	(14)	2 CC	B, SB
Spinach	2	(2)	21	2.8 CC	G, B, SB
Golf Course Turf, Ornamental Lawns And Turf, Ornamental Sod Farm (Turf), Recreation Area Lawns	2.7	3 CC	17	(4.2)	G, B, C
Papaya	3.6	2	14	7.2	G, B
Citrus (trees)	4	(3)	90	12	A,G,SB,B,D
Avocado, Deciduous Fruit Trees (Unspecified), Stone Fruits, Tree Nuts	4.1	(3)	90	12.3	A, G, B, SB
Citrus (Nursery stock)	10.2	(2)	90	(20.4)	SD

[1]T-REX input, taken from label corresponding to maximum treatment rate.

[2] Parenthesis indicate that information was not expressly stated on the label, but was assumed based on available data. In the case of maximum retreatment interval, a retreatment interval of 7 days was conservatively assumed when data were not available.

[3] CC indicates that labeled rates are stated in terms of application per crop cycle instead of annual application rate.

Table 3.2. Use Patterns of Mefenoxam Included in this Assessment Based on Uses with Adequate Label Information.

Uses	Maximum rate / single application	Formulated Product Application Rate (fl oz/ CWT) [1]	% ai [1]	Maximum rate /year (lbs ai./A)	Application type
Seed Treatment					
Barley, Triticale, Wheat	0.00005971 lbs ai/ lb seed	4.0	1.93	NA	ST
Oilseed Group 20 (except cotton and sunflower)[2]	**0.000075 lbs ai/lb seed**	**0.32**	**33.3**	**NA**	**ST**
Sweet Corn	0.00007464 lbs ai/ lb seed	5.0	1.93	NA	ST
Cotton	0.00008658 lbs ai/ lb seed	1.9	5.8	NA	ST
Legume Vegetables	0.00003713 lbs ai/ lb seed	1.1	5.0	NA	ST
Soybeans	0.00015038 lbs ai/lb seed	4.2	4.8	NA	ST
Uses	**Maximum rate / single application (lbs ai./lb seed)**	**Maximum rate / single application (lbs ai./ CWT)**	**Minimum Retreatment Interval (days)**	**Maximum rate /year (lbs ai./A)**	**Application type**
Aerial/Ground application					
Broccoli, Chinese Broccoli, Brussels Sprouts, Cabbage, Chinese Cabbage, Cauliflower	0.062494	(8)[3]	14	0.5	A,G
Bulb Vegetables	0.065528	1 CC[4]	NA	1 CC	Furrow
Beans (succulent, snap), Caneberries	0.1	2	7	0.2 CC	G, C
Garlic	0.1	(5)	7	0.5 CC	A, G
Pepper, Radish	0.1	4	(7)	1.5	G, C
Potato	0.1	(2)	14	0.188 CC	A,G
Leek, Shallot	0.104	(3)	(7)	0.3	A, G, B
Melons, Pumpkin, Squash, Cucumber	0.135	(4)	10	0.5	A, G, B
Hops	0.25	(1)	NA	0.25	SD
Kiwi	0.35	5 CC	30	1.75	SD
Ginseng	0.38	(4)	30	1.5	G
Fruiting Vegetables	0.5	(3)	(7)	1.5	A, G
Legume Vegetables	0.5	(1)	NA	0.5	A, G, C
Strawberry	0.5	3 CC	(7)	1.5 CC	G, C
Turf	0.68	3 CC	7	2.04 CC	G
Cranberry	0.88	3 CC	(7)	2.65 CC	B, C
Carrots, Cucurbit Vegetables, Leafy Vegetables, Cole Crops	1	1	NA	1	A, G, C
Herbs	1	(2)	(7)	2 CC	G, B
Spinach	1	NA	NA	1	G
Tomato	1	(2)	(7)	1.5 CC	A,G,C

Subtropical fruit	1.5	2 CC	(7)	3 CC	G, C
Tobacco	1.5	1	NA	1.5	G
Blueberry, Bush Berries	1.80	(2)	(7)	3.6 CC	A, G
Raspberry	1.81	2 CC	(7)	3.62 CC	G, B, SB
Orchards (Unspecified), Stone Fruits, Tree Nuts, Avocado, Deciduous Fruit Trees (Unspecified)	2	(3)	60	6	G
Citrus	2	3	90	6 CC	A,G, C

A= Aerial, G=Ground, C= Chemigation, SB= Soil Band Treatment, B= Broadcast, SD= Soil Drench treatment.

[1] T-REX input, taken from label corresponding to maximum treatment rate.

[2] The crop conversion from canola to Oilseed Crop Group 20 (except cotton and sunflower) is a proposed new action. Oilseed crop group 20 includes Borage, Calendula, Canola, Castor oil plant, Chinese tallowtree, Crambe, Cuphea, Echium, Euphorbia, Evening primrose, Flax seed, Gold of pleasure, Hare's ear mustard, Jojoba, Lesquerella, Lunaria, Meadowfoam, Milkweed, Mustard seed, Niger seed, Oil radish, Poppy seed, Rapeseed (including canola), Safflower, Sesame, Stokes aster, Sweet rocket, Tallowwood, Tea oil plant, Vernonia.

[3] Parenthesis indicate that information was not expressly stated on the label, but was assumed based on available data. In the case of maximum retreatment interval, a retreatment interval of 7 days was conservatively assumed when data were not available.

[4] CC indicates that labeled rates are stated in terms of application per crop cycle instead of annual application rate.

The most recent Screening Level Usage Analysis (SLUA) reports, provided by the Biological and Economic Assessment Division (BEAD), estimate the pesticide usage data for metalaxyl and mefenoxam on agricultural crops in the United States from the 2004-2013 period. The highest usage for metalaxyl in terms of annual average pounds applied was as a seed treatment on soybean, where 70,000 lbs were used. In terms of average and annual percent crop treated, use as a seed treatment on wheat is the highest, with 15 and 20% treatment, respectively. The highest uses of mefenoxam in terms of annual average lbs applied were oranges, potatoes, soybeans (seed treatment), tobacco, and tomatoes; where in all cases, average annual application was equal to or greater than 30,000 lbs/year. In terms of percent crop treated, the highest was spinach, where an average of 45% was treated, with a maximum of 70%.

3.3. Uncertainties

3.3.1. Label Uncertainties

EFED used the best available label information in this risk assessment. Due to vague label language and/or missing information on some labels, including the maximum number of applications per year, the maximum annual application rate and the minimum retreatment intervals, specific application rates were not specifically assessed as part of this document. As a result, higher application rates are presumed to be representative of risks from lower rates where label information was insufficient. To the extent that use rates exceed the rates assessed in this document, this PRA may under-represent risk. **Appendix K,** shows a summary of usage information and highlights missing label information.

The following uses are missing some information on their respective labels and as a result, assumptions were made so they could be included in the assessment. These assumptions may misrepresent actual exposure. More information is available in **Table 3.1**.

Metalaxyl- Christmas Tree Plantations, Commercial/Industrial Lawns, Forest Trees (Softwoods, Conifers), Residential Lawns, Fruiting Vegetables, Strawberry, Cole Crops, Cucurbit Vegetables, Leafy Vegetables, Lettuce, Root And Tuber Vegetables, Stone Fruits, Tree Nuts.

Mefenoxam- Broccoli, Chinese Broccoli, Brussels Sprouts, Cabbage, Chinese Cabbage, Cauliflower, Garlic, Pepper, Radish, Leek, Shallot, Ginseng, Fruiting Vegetables, Herbs, Cranberry, Tomato, Blueberry, Bush Berries, Orchards (Unspecified), Stone Fruits, Tree Nuts, Avocado, Deciduous Fruit Trees (Unspecified).

The following uses lacked sufficient label information for EFED to make reasonable assumptions about use information. As a result, risk conclusions for these uses are presumed to be equal to the highest assessed rates for metalaxyl (citrus) and mefenoxam (citrus). If any uses exceed the maximum assessed rate, this assessment may underrepresent risk from these uses:

Metalaxyl- Alfalfa, Almond, Apple, Blueberry, Asparagus, Clover, Ginseng, Grass Forage/Fodder/Hay, Legume Vegetables, Onion, Ornamental and/or Shade Trees, Ornamental Herbaceous Plants, Ornamental Nonflowering Plants, Ornamental Woody Shrubs And Vines, Ornamentals (Unspecified), Peanuts, Pineapple, Potato, White/Irish (Or Unspecified), Soybeans (Unspecified), Sugar Beet, Tobacco, Trefoil.

Mefenoxam- Alfalfa, Apple, Artichoke, Asparagus, Clover, Conifers (Plantations/Nurseries), Cotton, Grass Forage/Fodder/Hay, Onion (bulb and Green), Peanuts, Pineapple, Soybeans, Sugar Beet, lettuce, Ornamentals (unspecified).

Additionally, the overall highest single application rate for all uses on metalaxyl is soil drench application to citrus nursery stock at a rate of 10.2 lbs ai/A (EPA Registration 71532-5 (1)). This label is missing critical usage information related to the maximum number of applications per year. As this is likely the highest use rate for metalaxyl, EFED presumed, based on vague label language, a maximum of two annual applications per year. The application rate for this use must be clarified, as this information has the potential to alter risk conclusions.

The use site "deciduous fruit trees," mentioned in two labels (Registration #100-794, 100-796), should be clarified, as this term is not listed in any crop groups according to 40 CFR 180.41, and may therefore affect the ability to effectively establish a tolerance level for this use.

3.3.2. Data Uncertainties

Bridging

- This risk assessment employs a bridging strategy for the environmental fate and transport properties of mefenoxam and metalaxyl. There is no consideration of enantioselective degradation or transport processes for the individual isomers of metalaxyl. Therefore, the environmental behavior of individual isomers is assumed to be similar with no impact on total metalaxyl/mefenoxam residue concentrations in surface water at a similar application rate. There uncertainty related to this strategy

from a fate perspective, as there is evidence that the *R*- and *S*- enantiomers may degrade at different rates, where the fungicidally-active *R*-enantiomer (mefenoxam) has been shown to degrade faster than the *S*-enantiomer in aerobic soils with a pH>5 (Buerge, et al., 2003; Buser et al., 2002).

- Both mefenoxam and metalaxyl have their respective ecotoxicology datasets, so each chemical is assessed separately. Where studies are not available for metalaxyl or mefenoxam, data for the other are used to estimate toxicity. This is consistent with the approach outlined in the problem formulation (USEPA, 2010). **Tables 5.1** and **5.2** suggest that toxicity between metalaxyl and mefenoxam varies slightly between non-target species. The following endpoints were bridged between metalaxyl and mefenoxam:
  - Seedling emergence toxicity for monocots
  - Freshwater fish early life-stage
  - Chronic mammalian toxicity
  - Acute toxicity to passerine birds
  - Chronic freshwater invertebrates

Environmental Fate

- Metalaxyl/mefenoxam residues of concern were considered in modeling. This approach assumes degradation products, CGA-62826 and CGA 119857, have equivalent toxicity to metalaxyl/mefenoxam. This approach is conservative because the kinetics are combined among the residues of concern and their mobility is determined by the most mobile representative compound.
- There is an uncertainty associated with the substantial amount of unextracted residues (up to 53.8%) reported in the aerobic soil degradation studies. These unextracted residues were included in the half-life calculations used to assess risk to aquatic organisms in this assessment, and resulted about 3% increase of the EECs. As the actual bioavailability of these residues is uncertain, their inclusion in this assessment may be slightly conservative to predict the risks associated with the aquatic organisms.
- No foliar dissipation data were submitted. As a result, EFED assumed a default value of 35 days.

Environmental Effects

Degradates and Unextracted Residues

- No toxicity data are available for the major degradation products, CGA-62826, CGA 119857, and unextracted residues. As a result, these degradates were conservatively assumed to be of equal toxicity to the parent and were included in the TTR approach which was used to estimate exposure to aquatic organisms from metalaxyl/ mefenoxam runoff. Use of ECOSAR to predict effects of acute exposure to aquatic organisms was not considered appropriate in this case because of the acid moiety of the degradation products. To estimate the potential impact on the risk conclusions of including the three major degradation products in the TTR, RQs for the highest

application rates of metalaxyl were calculated for three scenarios, 1) the parent and major degradates, 2) parent and major degradates CGA-62826 and CGA 119857 excluding unextracted residues, and 3) parent only. The results are shown in **Table 3.3**. As shown in the table, the exclusion of major degradates does not change chronic risk conclusions for estuarine/marine invertebrates, with the exception of application to citrus nursery stock in Florida, where chronic RQs calculated based on parent only are below the chronic LOC for aquatic species (=1). For acute estuarine/marine RQ's, exclusion of all major degradates results in an RQ value below the acute LOC for listed aquatic species (=0.05).

Table 3.3. A Comparison of RQs with and without the Inclusion of Unextracted Residues and Major Degradation Products

Crop Scenario	Modeling Scenario	Peak EEC (µg ai/L)	21-Day Average EEC (µg ai/L)	Acute E/M Invertebrate RQ	Chronic E/M Invertebrate RQ
FL Citrus (Trees)	TTR	908	892	0.05	**1.21**
	w/o Unextracted Residues	892	876	0.05	**1.18**
	Parent Only	766	755	0.04	**1.02**
FL Citrus (Nursery stock)	TTR	962	942	0.05	**1.27**
	w/o Unextracted Residues	934	914	0.05	**1.24**
	Parent Only	721	700	0.04	0.95
MI Cherry	TTR	960	955	0.05	**1.29**
	w/o Unextracted Residues	947	942	0.05	**1.27**
	Parent Only	866	862	0.05	**1.16**

Bolded values meet or exceed the LOC for non-listed species of 0.5 for acute risk or 1.0 for chronic risk.
Shaded values meet or exceed the LOC for listed species of 0.05 for acute risk or 1.0 for chronic risk.

Unreviewed data

- As discussed above, several studies were submitted by the Registrant following the publication of the problem formulation which are currently under review by the Agency. Preliminary evaluation of these data indicate that the endpoints reported in these studies are less sensitive than existing endpoints, so there is a low potential for the results of these studies to change risk conclusions. As a result, these studies will be reviewed after the completion of this assessment.

Honeybees

- The honeybee acute contact toxicity study with metalaxyl (MRID 40276701), conducted with metalaxyl, did not report the percent active ingredient of the test material, but only mentions that it is performed with a technical grade test material. As a result, there is some uncertainty related to the acute contact toxicity of metalaxyl. As the non-definitive endpoint (>100 µg ai/bee) is more than 7 times greater than the highest adult contact EEC for metalaxyl (11.07 µg ai/bee), it is likely to be protective of risks to adult honeybees from acute exposure on a contact basis.
- While no risks to terrestrial invertebrates are identified based on acute contact exposure routes, no toxicity data are available with which to assess chronic exposure to adult honey bees or acute or chronic exposure to larval bees. In addition, label information is incomplete for some pollinator attractive crops (almonds, alfalfa, ect.).

These exposure routes remain significant uncertainties for the assessment of the impact of metalaxyl and mefenoxam on pollinators.

Estuarine/Marine Fish

- Chronic toxicity studies with estuarine/marine fish were not submitted for metalaxyl or mefenoxam. Use of an Acute to Chronic Ratio (ACR) is not appropriate in this case because the acute endpoints for freshwater and estuarine/marine fish are non-definitive. In the absence of chronic estuarine/marine fish, the chronic endpoints for freshwater fish (fathead minnow NOAEC=9.1 mg ai/L; MRID 00071308) will be used to estimate risk. There is uncertainty with this approach, as non-definitive acute toxicity data means that toxicity between freshwater and estuarine/marine fish cannot be directly compared, and it is unclear whether fathead minnows are most sensitive test species. As no chronic risk concerns were identified for chronic exposure of mefenoxam to freshwater fish, it is assumed that no chronic risk concerns exist for estuarine/marine fish. A comparison of the chronic endpoint with the highest overall 60-day EEC of 0.948 mg ai/L indicates that estuarine/marine fish would need to be at least 10 times more sensitive than freshwater fish to trigger a risk concern, which is sufficiently conservative to presume a low probability of chronic risk to estuarine/marine fish.

Aquatic Plants

- A vascular aquatic plant toxicity study conducted with mefenoxam (MRID 43875307) reported a significant reduction in the number of fronds at all test concentrations. As a result, a definitive NOAEC value (<3.0 mg ai/L) could not be determined for vascular aquatic plants. As a result, RQ values for listed vascular aquatic plants could not be calculated and risk to this taxa is presumed for all uses. A comparison of the highest peak EEC (443 µg ai/L) for mefenoxam, calculated based on aerial application to citrus in Florida, with the non-definitive NOAEC for vascular aquatic plants indicates that a NOAEC value that is 6x lower than the lowest test concentration would be sufficient to trigger a risk concern to listed vascular aquatic plants.

Birds

- Passerine data were not submitted for mefenoxam. As a result, the most sensitive avian endpoint, for acute exposure of metalaxyl to canaries, is used to assess acute risk to birds, reptiles and terrestrial-phase amphibians from mefenoxam.
- Due to the non-definitive avian dietary toxicity endpoints, acute dietary toxicity to non-listed species is uncertain for uses resulting in EECs greater than 1000 mg/kg-diet for metalaxyl (which includes all uses higher than those for eggplant, pepper and tomato), and EECs greater than 483 mg ai/kg-diet for mefenoxam (which includes most use rates higher than turf). No effects were observed in the subacute dietary studies, however, acute and chronic risk to birds was identified for both metalaxyl and mefenoxam.

Mammals

- The magnitude of risk to mammals from chronic dietary exposure to metalaxyl and mefenoxam is uncertain. The 2-generation reproduction study (MRID 00071600) conducted with metalaxyl did not observe reproductive effects up to the highest test concentration. As a result, in this risk assessment, the NOAEC was assumed to be the highest test concentration (NOAEC=1250 mg/kg-diet). Use of this NOAEC value may overestimate RQ values. Submission of additional data to characterize dietary risk to mammals may avoid unnecessary mitigation measures and more accurately represent risk during future endangered species assessments.

4. Exposure Assessment

The available physical/chemical and environmental fate properties of metalaxyl/mefenoxam and its degradates of concern were used to calculate exposure model input parameters to estimate potential environmental concentrations. The residues of concern (ROC) or total toxic residues (TTRs) include the parent compounds metalaxyl/mefenoxam and two degradates (CGA-62826 and CGA 119857) that occurred at greater than 10% of the applied dose in laboratory fate studies. The most recent standard models used to evaluate potential exposures to aquatic and terrestrial organisms can be found at http://www.epa.gov/pesticides/science/models_db.htm.

4.1. Environmental Fate and Transport

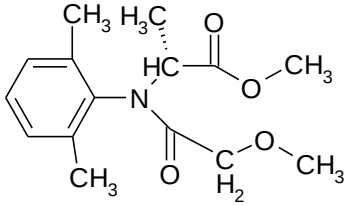
The environmental fate and transport data for metalaxyl and mefenoxam were bridged based on structural similarity (USEPA 2007, DP324495 and 2010b, D368463). This allowed fate data of both ingredients to be used interchangeably in the risk assessment. The review concluded that mefenoxam will be less persistent in the aerobic soils (MRID 47886102 and 47886104). The parent compound is stable to hydrolysis ($t_{1/2}$ > 200 days) in pH 5 and pH 7 buffer solution (MRID 00104493). It is also considered stable to photodegradation on soil surfaces (MRID 43883402) and it persists in aquatic environments ($t_{1/2}$ = 400 days) (MRID 41156001). The parent compound is moderately persistent in aerobic mineral soils with half-lives of 37.5 days (MRID 00104494), 85.8 and 65.5 days (MRID 43935301), 10.1 days (MRID 47886102) and 26.4 days (MRID 47886104). The major aerobic degradation product was found to be CGA-62826 (N-(2, 6-dimethylphenyl)-N-(methylacetyl-L-alanine)). Both the parent and the primary degradate CGA-62826 are capable of leaching to the 36 to 48 inch soil depth and have potential to reach the groundwater. A substantial amount of the unextracted residues (up to 54%) were reported in several soil studies (MRIDs 00104494, 47886102 and 47886104). The parent compound was found to be moderately persistent (half-life of 29 days) under an anaerobic water-sediment environment, where it transformed into two major degradates, CGA-62826 (48%) and CGA 119857 (16%) at 385 days (MRID 42259801). It is also moderately persistent under aerobic aquatic environments (half-life range of 22 to 55 days; MRIDs 42259802 and 47886101), where it transforms to one major degradate, CGA-62826 (76% at 240 days). The environmental persistence is assumed for the acid degradates, CGA-62826 and 119857, due to the lack of the environmental fate data.

Metalaxyl/mefenoxam is expected to be moderately mobile in soil and aquatic environments, with Freundlich adsorption coefficients (Kd) that range from 0.1 (Koc=20) in sand to 7.6 (Koc=570) (MRID 43875309). The degradate, CGA-62826, is expected to be very highly mobile in soil and aquatic environments (Mean Koc = 39, range = 31-45; MRID 47886103). Both parent and degradate CGA-62826 are readily leached in soil columns of sand textured soils with low organic matter and were detected in the leachate from aged soil column leaching studies (MRID 43935302). In addition, the parent compounds have a low volatilization potential from soil, with a vapor pressure of 2.2×10^{-6} mm Hg at 25ºC, and a low potential to bioconcentrate, with a whole-fish bioconcentration factor of <7x.

Under typical use conditions, metalaxyl/mefenoxam was found to be moderately persistent ($t_{1/2}$=27 - 56 days) in field dissipation studies (MRIDs 40985403, 40985404, 41765001, 41765002 and 41809301). In aquatic field dissipation studies, the parent compound had half-lives of 5 - 20 days in rice paddy water and 11 - 24 days in soil (MRIDs 42259803 and 42259804). The major degradation product, CGA-62826, was found in several field dissipation studies. In one study, metalaxyl dissipated with a half-life of 56 days from the upper 6 inches of bareground plots of loamy sand soil in California after a broadcast application of metalaxyl (Ridomil 2E, 2 lbs/gallon EC) at 8 lbs a.i./A. The degradate, CGA-62826, was detected in the 0 to 6 inch soil depth at all sampling intervals. Metalaxyl and CGA-62826 leached to the 36 to 48 inch soil depth; leaching correlated with significant amounts of irrigation water applied to the plots (MRID 41765001). In the second study, metalaxyl dissipated with a half-life of 50 days from the upper 6 inches of plots of sandy loam soil in a California citrus grove following the last of three applications (3-month intervals) of metalaxyl (Ridomil 2E, 2 lb/gallon EC) at 4.4 lbs a.i./A. The degradate, CGA-62826, was detected in the 0 to 6 inch soil depth at most sampling intervals. Metalaxyl leached to the 24 to 36 inch soil depth and CGA-62826 leached to the 36 to 48 inch soil depth (MRID 41765002). In the third study, metalaxyl dissipated with half-lives of 38 to 39 days from the upper 6 inches of bareground and cropped tobacco plots of loamy sand soil in North Carolina after a single broadcast application of metalaxyl (Ridomil 2E, 2 lb/gallon EC) at 4.3 lbs a.i./A. The degradate, CGA-62826, was detected in the 0 to 6 inch soil depth at most sampling intervals. Metalaxyl and CGA-62826 leached to the 36 to 48 inch soil depth; however, leaching patterns were confounded with apparent contamination during sampling (MRID 41809301). These field results are consistent with the results of the laboratory studies. **Tables 4.1** and **4.2** list the environmental fate and transport properties for metalaxyl/mefenoxam and the major degradate CGA 62826, respectively. The degradates and their amounts formed in the submitted environmental fate studies are listed in **Appendix A**.

Table 4.1. Environmental Fate and Transport Properties for Metalaxyl/Mefenoxam

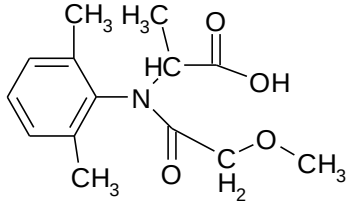
Parameter	Value	Reference
Physical/Chemical Parameters		
CAS Name	Methyl N-(2,6-dimethylphenyl)-N-(methoxyacetyl)-D-alaninate	
CAS Number	70630-17-0	MRID 47886102
Molecular formula	$C_{15}H_{21}NO_4$	MRID 47886102

Parameter	Value	Reference
Molecular Weight	279.34 (g/mole)	MRID 47886102
Molecular Structure		EPI Suite (v4.11)
SMILES	OCC(=O)N(c1c(C)cccc1C)[C@H](C)C(=O)OC	
Vapor pressure (20°C)	$2.2E^{-6}$	MRID 00079041
Henry's Law constant (25°C)	$8.05E^{-10}$	EPI Suite (v4.11)
Water solubility (mg/L at 25ºC)	26,000	MRID 47886102
Log Kow	1.65	EPI Suite (v4.11)
Persistence in Water		
Hydrolysis half-life (at 50 °C, pH 5 & 7)	Stable (>200 days)	MRID 00104493
Aqueous photolysis half-life (25°C)	400 days	MRID 41156001
Aerobic aquatic metabolism half-life (25°C)	55.1 d (SFO^{1}) 47.5 d ($IORE^{1}$) and 22.4 d ($IORE^{1}$)	MRID 42259802 MRID 47886101
Anaerobic aquatic metabolism half-life (25°C)	29.2 d (SFO^{1})	MRID 42259801
Persistence in Soil		
Soil photolysis half-life (25°C)	Stable	MRID 43883402
Aerobic soil metabolism half-life (20°C)	37.5 d (SFO^{1}) (clay loam)	MRID 00104494
	85.8 d (SFO^{1}) (sandy loam, mefenoxam)	MRID 43935301
	60.5 d (SFO^{1}) (sandy loam, metalaxyl)	
	10.1 d (SFO^{1}) (sandy clay loam)	MRID 47886102
	26.4 d (SFO^{1}) (sandy loam soil)	MRID 47886104
Mobility		
Freundlich organic carbon normalized soil-water partitioning coefficient (K_{FOC}) L/kg	Clay = 570, Sand = 20, Sandy Loam = 68 Loam = 86, Si CL Lo = 1299	MRID 43875309

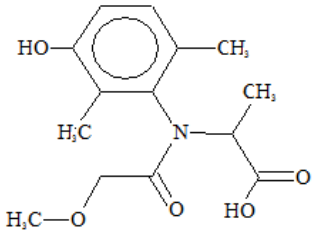
Parameter		Value	Reference
Field Dissipation			
Terrestrial field dissipation half-life[2] (Detected leaching depth detection and time)	Unvegetated plot, -sandy loam soil	CA: 36 d (0-6" depth at day 0)	MRID 40985403
	Tomato plot, -sandy loam soil	CA: 27 d (0-6" depth at day 0)	MRID 40985404
	Bare plot, - loamy sand soil	CA: 56 d (36-48" depth at day 270)	MRID 41765001
	Vegetated and tobacco, -bare soil plot	NC: 38-39 d (24-36" depth at day 3 in vegetated plot) (36-48" depth at day 0 in tobacco plot)	MRID 41765002
	Citrus plot, -sandy loam soil	CA: 50 d (36-48" depth at day 14)	MRID 41809301
Aquatic field dissipation half-life[2] (Detected leaching depth detection and time)	Rice paddy, -Alamo clay	CA: 20 d paddy water and 24 d soil (3-6" depth at day 0)	MRID 42259803
	Rice paddy, -Falaya silt loam	CA: 5 d paddy water and 11 d soil (6-9" depth at day 7)	MRID 42259804
Fish bioconcentration factors (depuration rate) - bluegill sunfish (*Lepomis mecrochirus*)		<7x (whole); <15x (inedible); <1x (edible) (>50% depuration in 3 days)	MRID 100468 (acc # 238232)

[1] Kinetics models used to calculate half-lives include Single First-Order (SFO), Double First-Order in Parallel (DFOP), and Indeterminate Order Rate Equation (IORE) in accordance with NAFTA guidance (USEPA, 2012).
[2] Field dissipation half-life is for the parent compound only and ranges include values following each of five terrestrial applications and two aquatic applications to the field. Half-lives following the terrestrial application on bare and vegetated plots were 27-56 days and following the aquatic application on rice paddy were 11-24 days.

Table 4.2. Environmental Fate and Transport Properties for Major Degradates CGA 62826 (or NOA 409045) and CGA 119857

Parameter	Value	Reference
Degradates CGA 62826		
Physical/Chemical Parameters		
CAS Name	N-(2,6-Dimethylphenyl)-N-(methoxyacetyl)-alanine.	
CAS Number	75596-99-5	MRID 47886102
Molecular Weight (g/mole)	265.31	EPI Suite (v4.11)
Molecular formula	$C_{14}H_{19}NO_4$	EPI Suite (v4.11)
Molecular Structure		
SMILES	OCC(=O)N(c1c(C)cccc1C)[C@H](C)C(=O)OC	

Parameter	Value	Reference
Vapor pressure (25°C)	$1.28E^{-8}$	EPI Suite (v4.11)
Henry's Law constant (25°C) (Bond)	$1.51E^{-9}$	EPI Suite (v4.11)
Water solubility (mg/L at 25ºC)	1,203	EPI Suite (v4.11)
Log Kow	1.4	EPI Suite (v4.11)
Mobility		
Freundlich organic carbon normalized soil-water partitioning coefficient (K_{FOC}) L/kg	B. Sandy Loam = 38, P. Sandy Loam = 31 G. Silt Loam = 43, V. Silt Loam = 45	MRID 47886103

Parameter		Value	Reference
Field Dissipation			
Degradate found in field dissipation (Detected leaching depth detection and time)	Unvegetated plot, -sandy loam soil	CA (0-6” depth at day 0)	MRID 40985403
	Tomato plot, -sandy loam soil	CA (0-6” depth at day 0)	MRID 40985404
	Bare plot, - loamy sand soil	CA (36-48” depth at day 270)	MRID 41765001
	Tobacco and bare soil plot	NC (24-36” depth at day 3 and 36-48” depth at day 212 in vegetated plot) (24-36” depth at day 3 in tobacco plot)	MRID 41765002
	Citrus plot	CA (36-48” depth at 9 months) (or 3 months after the third application at 3 month application interval)	MRID 41809301
Aquatic field dissipation	Rice paddy, -Alamo clay	CA: (3-6” depth at day 14)	MRID 42259803
	Rice paddy, -Falaya silt loam	CA: (6-9” depth at day 14)	MRID 42259804
Degradates CGA 62826			
Physical/Chemical Parameters			
CAS Name		N-(3_hydroxy-2, 6-dimethylphenyl)-N-(methoxyacetyl)-L-alanine	
Molecular Weight (g/mole)		281.31	
Molecular formula		$C_{14}H_{19}NO_5$	
Molecular Structure			
SMILES:		CC1=C(C(=C(O)C=C1)C)N([C@H](C)C(=O)O)C(=O)COC	
Vapor pressure (25°C)		$2.13E^{-9}$	EPI Suite (v4.11)
Henry’s Law constant (25°C) (Bond)		$2.62E^{-16}$	EPI Suite (v4.11)
Water solubility (mg/L at 25ºC)		2,190	EPI Suite (v4.11)
Log Kow		1.0	EPI Suite (v4.11)

4.2. Residues of Concern

The residues of concern (ROC) or total toxic residues (TTRs) include the parent compounds metalaxyl/mefenoxam and two degradates (CGA-62826 and CGA 119857) that occurred at greater than 10% of the applied dose in laboratory fate studies. In addition, the unextracted residues (>30%) was also considered as the residues of concern (Appendix A).

Unextracted residues formed >30% of the applied in three submitted aerobic soil metabolism studies (MRIDs 00104494, 47886102 and 47886104). Among them, one 120-d study reported up to 54.5% unextracted residues and 27.6% CGA-62826 (MRID 47886102). In a correspondence email dated on April 18, 2016, the registrant "*contends that extraction with a range of less polar solvents would not lead to greater extractability*". However, an extraction method for better extraction efficiency was reported with three different extractants: 1) Acetonitrile:HOAc (8:2); 2) MeOH:H_2O (9:1) and 3) Dimethylformamide:1M HOAc (1:1) in a submitted 160-d aerobic soil metabolism study, in which the unextracted residues were only 4.3%, but the maximum CGA-62826 concentration reached up to 73.5% (MRID 43935301). The ambiguous evidence shows a possible correlation between the decreasing of unextracted residue and increasing of CGA-62826, which leads to an assumption that the unextracted residue should be considered as a ROC until further clarification.

Table 4.3 provides environmental fate parameters for the metalaxyl/mefenoxam ROC. All half-lives were recalculated to include the ROC. As a result, the hydrolysis, aqueous photolysis and soil photolysis are all stable. The aerobic aquatic metabolism half-lives of the ROC are much longer than that of the parent compounds. Three different versions of the aerobic soil metabolism half-lives of the ROC were calculated with and without the incorporation of unextracted residues as well as the parent only. This approach brackets high-end and low-end availability scenarios for residues undergoing aerobic soil metabolism and may be used for the characterization of the soil half-life effect on the residue concentrations. In addition, the soil mobility for parent compound (moderately mobile) and for CGA-62826 (very highly mobile) are considered for surface water exposure modeling scenarios.

Table 4.3. Environmental Fate Parameters of Metalaxyl/Mefenoxam Residues of Concern

Parameter	Value	Source
Persistence in Water		
Hydrolysis half-life (pH 5 and 7)	Stable	MRID 00104493
Aqueous photolysis half-life (25°C)	Stable	MRID 41156001
Anaerobic aquatic metabolism half-life (25°C)	1,456 d[1]	MRID 42259801
Aerobic aquatic metabolism half-life (25°C)	220 d (SFO)[2, 3] 660 d (DFOP)[2, 3] and 665 d (SFO)[2, 3]	MRID 42259802 MRID 47886101
Persistence in Soil		
Soil photolysis half-life (25 °C)	Stable	MRID 43883402
Aerobic soil metabolism half-life (20°C) (Excluding unextracted residues) Scenario 1	158 d (SFO) 751 d and 761 (SFO) 17.3 d (SFO) 86.8 d (SFO)	MRID 00104494 MRID 43935301 MRID 47886102 MRID 47886104
Aerobic soil metabolism half-life (20°C) (Including unextracted residues) Scenario 2	5,360 d (IORE)[2, 3] 917 and 923 d (SFO)[2, 3] 6,513 d (IORE)[2, 3] 2,450 d (IORE)[2, 3]	MRID 00104494 MRID 43935301 MRID 47886102 MRID 47886104

Parameter	Value	Source
Aerobic soil metabolism half-life (20°C) (Parent metalaxyl.mefenoxam only) Scenario 3	37.5 d (SFO[1]) 85.8 d and 60.5 d (SFO[1]) 10.1 d (SFO[1]) 26.4 d (SFO[1])	MRID 00104494 MRID 43935301 MRID 47886102 MRID 47886104
Mobility		
Freundlich organic carbon normalized soil-water partitioning coefficient (K_{FOC}), Parent	570, 20, 68, 86 and 1299 Mean = 409	MRID 43875309
Freundlich organic carbon normalized soil-water partitioning coefficient (K_{FOC}), CGA-62826	38, 31, 43 and 45 Mean = 39	MRID 47886103

[1] The DT_{50} was recalculated to include CGA-62826 (maximum of 48.07%) and CGA-119857 (maximum of 16.25%)
[2] The DT_{50} was recalculated to include CGA 62826
[3] IORE, DFOP and SFO are kinetics models used to generate the reported half-lives. The models were selected following the NAFTA kinetics guidance (USEPA, 2012).

EFED has completed the drinking water assessment (DWA) for a systemic phenylamide fungicide, metalaxyl and mefenoxam, in support of human health risk assessments of the Health Effect Division (HED) for Registration Review. The maximum estimated drinking water concentrations (EDWCs) of the residues of concern (ROC) are not expected to exceed **6,512 µg/L** for acute exposure and **4,413 µg/L** for chronic exposure from groundwater sources and not expected to exceed **444 µg/L** for acute exposure and **248 µg/L** for chronic exposure from surface water sources (USEPA 2016b. DP 433140)

4.3. Aquatic Exposures

A TTR approach was used to estimate aquatic exposure with the ROC half-lives (**Table 4.3**) and the chemical properties of metalaxyl/mefenoxam and its degradate CGA-62826 (**Tables 4.1 and 4.2**). The TTR approach is justified because there are two degradates of concern, for which a full environmental fate and ecotoxicological data profiles are unavailable. Chemical property and environmental fate input values were chosen in accordance with current input parameter guidance (USEPA, 2009). The average Koc of the parent compound (Koc=409) is used because it represents the reasonable soil mobility for surface water environments. Based on analysis of the ROCs, the 90th percentile confidence bounds on the mean half-lives for aerobic soil metabolism, aerobic aquatic metabolism, and anaerobic aquatic metabolism were selected. The three times a single half-life value for anaerobic aquatic metabolism (1,456 × 3 = 4,368d) was used according to EFED model input guidance (USEPA 2009). The 90th percentile average aerobic soil metabolism half-life for ROCs including unextracted residues ($t_{1/2}$=5,000d, input scenario 2) is about 8.2 times of that for ROCs excluding unextracted residues ($t_{1/2}$=608d, input scenario 1) and 81 times of that for parent only.

Surface water sourced water exposure was estimated using the Tier II exposure model PWC (pesticide water calculator v1.5; December 8, 2015). The PWC is a graphical user interface that runs the Pesticide Root Zone Model (PRZM, v 5, November 15, 2006) and the Variable Volume Water Body Model (VVWM, 3/6/2014) (USEPA, 2006b). **Table 4.4** lists the chemical input parameters for PWC. Model input and output files are attached in **Appendix B**.

For the cranberry use, two different modeling methodologies were employed, for the following reason. Some cranberries are grown in bogs that are temporarily flooded to control pests, prevent freezing, and/or facilitate harvest. Cranberries may also be grown in settings that more closely resemble the cultivation of more widely-grown field crops, in which flooding is not employed as a management practice. Water from an intentionally-flooded cranberry bog may be held in a holding system, recirculated to other cranberry growing areas, or released to an adjacent waterbody (*e.g.*, river, stream, lake). The Provisional Cranberry Model (v 2.0, December 9, 2010) was used to generate screening-level EECs in water within or released from a cranberry bog. The Provisional Cranberry Model is based on the same assumptions as the Tier I Rice Model (v1.0, May 8, 2007), with the addition of degradation processes in dry and flood conditions and a water depth of twelve inches in the flooded cranberry bog. The cranberry bog water depth of twelve inches is a maximum depth recommended by the Cape Cod Cranberry Growers Association (2001). Degradation of metalaxyl/mefenoxam residues of concern is assumed to occur predominantly via aerobic microbial metabolism, whether on dry cranberry bog soil or in bog flood water. The inputs and equations used in the Provisional Cranberry Model are briefly described in **Appendix L**. To account for aquatic exposures that occur as the result of rainfall-runoff that occurs after chemical application but before or after deliberate flooding, as well as to represent cranberries that are grown and harvested without the use of flooding at all, the PWC scenarios are used as a proxy for cultivation.

Table 4.4. PWC and Provisional Cranberry Model Chemical Input Parameters for Metalaxyl/Mefenoxam ROC[1]

Input Parameter	Value	Justification	Source
Organic carbon partition coefficient (K_{OC}) (L/kg_{OC})	409	Represents the mean K_{FOC} value of metalaxyl/mefenoxam Koc (n=5)	MRID 43875309
Aerobic aquatic metabolism half-life (days) [temp. (25 °C)]	790	Average = 515.7, SD=254.3, $t_{90,n-1}$ = 1.866, n=3 [2]	MRID 42259802 MRID 47886101
Anaerobic aquatic metabolism half-life (days) [temp. (25 °C)]	4,368	Represents a single soil half-life value times three [3]	MRID 42259801
Aqueous photolysis half-life (days) [latitude (40 °N)]	Stable	Represents the single value for the residues of concern (Included the CGA-62826)	MRID 41156001
Hydrolysis half-life at pH 7 (days)	Stable		MRID 00104493
Aerobic soil metabolism half-life for parent only (days), [20 °C] (input scenario 3)	62	Represents the upper 90% confidence bound on the mean of five half-lives for the ROC (Parent metalaxyl/mefenoxam only) [3]	MRID 00104494 MRID 43935301 MRID 47886102 MRID 47886104
Aerobic Soil Metabolism half-life that that excluded the unextracted residues (Days), [20°C] (input scenario 2)	608	Represents the upper 90% confidence bound on the mean of five half-lives for the ROC (Excluding the unextracted residues) [3]	MRID 00104494 MRID 43935301 MRID 47886102 MRID 47886104
Aerobic soil metabolism half-life that included the unextracted residues (days), [20 °C] (input scenario 1)	5,000	Represents the upper 90% confidence bound on the mean of five half-lives for the ROC (Including the unextracted residues) [3]	MRID 00104494 MRID 43935301 MRID 47886102 MRID 47886104

Input Parameter	Value	Justification	Source
Foliar half-life (days)	0	Default value in the absence of data	USEPA, 2009
Molecular mass (g/mol)	279.34	Metalaxyl/Mefenoxam molecular mass	MRID 47886102
Vapor pressure (torr)	2.2E-6	Study value for metalaxyl/mefenoxam	MRID 00079041
Solubility in water (mg/L)	26,000	Study value for metalaxyl/mefenoxam	MRID 47886102

[1] Source data are in **Tables 2, 3 and 4.**
[2] Calculated 90th confidence bound on the mean of three half-life value; t_{input} = average $t_{1/2}$ + [$t_{90,n-1}$ * SD]/SQRT(n)
[3] EFED Input Guidance (USEPA. 2009).

The use pattern inputs for the PWC model are listed in **Table 4.5**. Modeled PWC scenarios were those applicable to the current and proposed new use sites that resulted in the highest exposure. Because the application rates for mefenoxam and metalaxyl vary, the maximum rates for both compounds were used. The maximum allowed application rates and numbers of applications per year on the labels were modeled. The initial application date (April 1) was selected within the scenario crop season and two more applications were selected on July 1 and October 1 as the label directed 3-month application interval.

Table 4.5. PWC and Provisional Cranberry Model Scenarios and Input Parameters Describing Maximum Patterns of Metalaxyl and Mefenoxam Uses on Representative Use Sites [1]

Use Site	PWC Scenario	Date of Initial App.	App. Rate in lbs a.i./A (kg a.i./ha)	App. per Year	App. Interval (days)	CAM Input	Method [2]	Application Efficiency/ Spray Drift
Metalaxyl Uses								
Citrus (Trees)	CA Citrus	April 1	4.1 (4.59)	3	90	2	A	0.95/0.125
		April 1	10.4 (11.65)	2	90	1	SD	1/0
	FL Citrus	April 1	4.1 (4.59)	3	90	2	A	0.95/0.125
		April 1	4.1 (4.59)	3	90	2	A (M-C)	0.95/0.089
		April 1	4.1 (4.59)	3	90	2	G	0.99/0.062
		April 1	10.4 (11.65)	2	90	1	SD	1/0
Deciduous Fruit Trees, Stone Fruits and Tree Nuts	GA Peach	April 1	4.1 (4.59)	3	90	2	A	0.95/0.125
	MI Cherry	April 1	4.1 (4.59)	3	90	2	A	0.95/0.125
		April 1	4.1 (4.59)	3	90	2	A (M-C)	0.95/0.089
		April 1	4.1 (4.59)	3	90	2	G	0.99/0.062
	NC Apple	April 1	4.1 (4.59)	3	90	2	A	0.95/0.125
	PA Apple	April 1	4.1 (4.59)	3	90	2	A	0.95/0.125
Cranberry	Provisional Cranberry Model[4]	NA	1.8	3	(14)		NA	NA
Mefenoxam Uses								
Citrus	CA Citrus	April 1	2 (2.24)	3	90	2	A	0.95/0.125
	FL Citrus	April 1	2 (2.24)	3	90	2	A	0.95/0.125
Deciduous Fruit Trees, Stone Fruits and Tree Nuts	GA Peach	April 1	2 (2.24)	3	90	2	G	0.95/0.125
	MI Cherry	April 1	2 (2.24)	3	90	2	G	0.95/0.125
	NC Apple	April 1	2 (2.24)	3	90	2	G	0.95/0.125
	PA Apple	April 1	2 (2.24)	3	90	2	G	0.95/0.125
Cranberry	Provisional Cranberry Model[4]	NA	0.88	3	(7)		NA	NA

[1] Source data are in **Appendix Table I-2**.
[2] A – Aerial spray, A (M-C) – Aerial spray (medium to coarse droplets), G – Ground spray and SD – Soil drench
[3] Not a SWCC scenario. Label specifies 45 day Pre-Harvest Interval. See **Appendix L** for details.

The results of the PWC simulations are in **Table 4.6**. Model outputs are included in **Appendix B**. These results represent the combined exposure for spray drift, runoff and eroded sediment at the edge of the treated field. The longer soil half-life (5,000 days) seems slightly increased the surface water concentrations (≤ 3%, e.g. (962 ppb / 934 ppb -1) × 100% = 3%) compared to the shorter soil half-life (608 days, excluded unextracted residues in the half-life calculation) as demonstrated by Florida citrus and Michigan cherry scenarios. However, if only parent metalaxyl/mefenoxam soil half-life (62 days) is applied to the model, there are about 25% surface water EEC reduction comparing to that of 5000 days soil half-life (e.g. (1 - 721 ppb / 962 ppb) × 100% = 25%). To be conservative, the longer soil half-life (5,000 days) were used to estimate the surface water concentration (**Table 4.6)**.

Table 4.6. Surface Water Concentrations for Metalaxyl/Mefenoxam Residues of Concerns [1]

Use	Scenario	Application Method	Application Rate, lbs ai/A & (No. of Applications)	Estimated Environmental Concentrations (EECs) (µg/L) [2]			
				1-in-10-year Peak Exposure	1-in-10-year 21-day Average Exposure	1-in-10-year 60-day Average Exposure	Spray Drift (% Drift)
Metalaxyl							
Citrus (Trees)[3]	CA Citrus (w23155.dvf)	Aerial Spray	4.1 & (3)	382	376	369	355 (93%)
	FL Citrus (w12844.dvf)	**Aerial Spray**	**4.1 & (3)**	**908 (892)[5] (766)[6]**	**892 (876)[5] (755)[6]**	**874 (856)[5] (741)[6]**	**281 (31%)**
	FL Citrus (w12844.dvf)	Aerial Spray (Medium to Coarse)	4.1 & (3)	837	821	802	201 (24%)
	FL Citrus (w12844.dvf)	Ground Spray	4.1 & (3)	811	795	776	146 (18%)
Citrus[4] (Nurserystock)	CA Citrus (w23155.dvf)	Soil Drench	10.4 & (2)	19.2	18.8	18.5	0
	FL Citrus (w12844.dvf)	**Soil Drench**	**10.4 & (2)**	**962 (934)[5] (721)[6]**	**942 (914)[5] (700)[6]**	**924 (896)[5] (674)[6]**	**0**
Deciduous Fruit Trees[3]	GA Peach (w03813.dvf)	Aerial Spray	4.1 & (3)	430	423	414	370 (86%)
	MI Cherry (w14850.dvf)	**Aerial Spray**	**4.1 & (3)**	**960 (947)[5] (866)[6]**	**955 (942)[5] (862)[6]**	**948 (936)[5] (856)[6]**	**643 (67%)**
	MI Cherry (w14850.dvf)	Aerial Spray (Medium to Coarse)	4.1 & (3)	786	779	774	464 (59%)
	MI Cherry (w14850.dvf)	Ground Spray	4.1 & (3)	672	667	662	329 (49%)
	NC Apple (w03812.dvf)	Aerial Spray	4.1 & (3)	782	776	769	461 (59%)
	PA Apple (w14751.dvf)	Aerial Spray	4.1 & (3)	795	789	782	477 (60%)
Cranberry	**Provisional Cranberry Model[6]**	**NA**	**1.8 & (3)**	**1653**	**1638**	**1581**	**NA**
Mefenoxam							
Citrus[3]	CA Citrus (w23155.dvf)	Aerial Spray	2 & (3)	186	184	180	173 (93%)
	FL Citrus (w12844.dvf)	**Aerial Spray**	**2 & (3)**	**443**	**435**	**427**	**138 (31%)**
Deciduous Fruit Trees[3]	GA Peach (w03813.dvf)	Ground Spray	2 & (3)	123	121	118	91 (74%)
	MI Cherry (w14850.dvf)	**Ground Spray**	**2 & (3)**	**328**	**325**	**323**	**161 (49%)**
	NC Apple (w03812.dvf)	Ground Spray	2 & (3)	284	282	279	114 (40%)
	PA Apple (w14751.dvf)	Ground Spray	2 & (3)	281	278	276	118 (42%)

Use	Scenario	Application Method	Application Rate, lbs ai/A & (No. of Applications)	Estimated Environmental Concentrations (EECs) (µg/L) [2]			
				1-in-10-year Peak Exposure	1-in-10-year 21-day Average Exposure	1-in-10-year 60-day Average Exposure	Spray Drift (% Drift)
Cranberry	**Provisional Cranberry Model[7]**	**NA**	**0.88 & 3**	**813**	**805**	**792**	**NA**

Bolded values represent the highest EEC for each use
[1] Maximum values for each input scenario are in bold
[2] The data in parentheses represent the model input 2, which includes the unextracted residues with the ROCs.
[3] Application dates: 4/1, 7/1 and 10/1 (mm/dd)
[4] Application dates: 4/1 and 7/1 (mm/dd)
[5] Modeled using the aerobic soil half-life 608 days (excludes the unextracted residues)
[6] Modeled using the parent aerobic soil half-life 62 days
[7] Not a scenario, reflects undiluted paddy water concentration, post-flood.

Benthic Invertebrate Exposure

Sediment testing is generally required if the following chemical characteristics exist:

- Kd ≥50
- LogKow≥3
- Koc≥1000

Metalaxyl/mefenoxam is expected to be moderately mobile in soil and aquatic environments, with Freundlich adsorption coefficients (Kd) that range from 0.1 (Koc=20) in sand to 7.6 (Koc=570) (MRID 43875309). In addition, the LogKow of metalaxyl/mefenoxam is predicted to be 1.65.As a result, risk quotients for water column invertebrates are protective of risk to benthic invertebrates.

4.4. Bioaccumulation

The bioconcentration factor (BCF) for metalaxyl/mefenoxam residues in bluegill sunfish (*Lepomis mecrochirus*) was <1x in edible fish tissues, <15x in non-edible fish tissues, and <7x in whole body (MRID 100468). Depuration half-lives were less than 3 days. Bioaccumulation is not a concern for metalaxyl/mefenoxam based on the estimated Log Kow (1.65).

4.5. Monitoring Data

Metalaxyl monitoring data were found in the NAWQA water quality portal (WQP) (Accessed on April 29, 2016, http://waterqualitydata.us/), which integrates public available water quality data from the USGS National Water Information System (NWIS), the EPA STOrage and RETrieval (STORET) Data Warehouse, and the USDA ARS Sustaining The Earth's Watersheds Agricultural Research Database System (STEWARDS). The maximum parent metalaxyl concentration was **46.4 µg/L** in New York surface water and **3.79 µg/L** in Washington groundwater below 12.5 feet. The parent residues were found in deep groundwater (90 feet) in California (0.02 µg/L), and 480 feet in New Hampshire (0.01 µg/L). In a registrant-performed prospective groundwater study in the mid-1980s, the maximum metalaxyl concentration was 3 µg/L in drinking water wells, which were located near a field treated up to 1.0 lb ai/A (USEPA 2007, DP324495). No monitoring data for mefenoxam or degradate CGA 62826 were found in the WQP database (Accessed April 29, 2016).

Metalaxyl/mefenoxam monitoring data were not found in the California Department of Pesticide Regulation (CDPR) surface water database (Accessed on April 29, 2016, http://www.cdpr.ca.gov/docs/emon/surfwtr/surfcont.htm). Metalaxyl was not detected in 27 groundwater samples taken in 2014 in Fresno County, California (http://www.cdpr.ca.gov/docs/emon/grndwtr/wellinv/wirmain.htm, 2015 Report).

Maximum concentrations of metalaxyl in the monitoring data (up to 46.4µg/L) are less than those from surface water modeling (825 µg/L) for a variety of reasons, including the lack of targeted monitoring analyses, lack of analysis for degradates of concern, potentially less usage in practice than the modeled use patterns, and uncertainty in the environmental fate data used in modeling, including uncertainty in the stability of metalaxyl/mefenoxam to hydrolysis and uncertainty in the availability of the unextracted residues.

4.6. Terrestrial Exposures

4.6.1. Birds and Mammals

Terrestrial wildlife exposure estimates are typically calculated for birds and mammals by emphasizing the dietary exposure as well as inhalation and drinking water exposure pathways. Metalaxyl and mefenoxam are applied through aerial and ground application methods, which includes sprayers, chemigation and soil drenching, as well as through seed treatments. Therefore, potential dietary exposure for terrestrial wildlife in this assessment is based on consumption of metalaxyl and mefenoxam residues on food items following spray or chemigation applications,

as well as resulting from possible dietary ingestion of metalaxyl/ mefenoxam residues on treated seeds.

EECs for birds and mammals through dietary items were calculated using T-REX v.1.5.2[5]. Within this document, only the highest and lowest EECs are shown in each table to highlight the large difference that results from the wide range of application rates registered for metalaxyl and mefenoxam. A complete list of EECs, as well as model inputs including application rates, number of applications, and intervals is available in **Appendix H**. A foliar dissipation rate of 35 days was used for this analysis to estimate dissipation after each application. Upper-bound Kenaga nomogram values are used to derive EECs for metalaxyl and mefenoxam exposures separately to terrestrial mammals and birds (**Table 4.8-4.12).** An example output from the T-REX model is also provided in **Appendix F**. Results of T-REX modeling of avian and mammalian estimated exposure concentrations (EECs) from consumption of metalaxyl and mefenoxam-treated seeds are provided in **Tables 4.8** and **4.10**. Results include Nagy dose-based values (*i.e.*, mg/kg-bw) and available mass of active ingredient per unit area (*i.e.*, mg ai/ft^2). Application rates in terms of lbs ai/A for the highest and lowest seed treatment rates were also calculated and shown below in **Table 4.7.** These values were calculated according to the following equation:

Table 4.7. Calculation of Maximum Seed Application Rate in lbs ai/A for Aquatic Exposure Modeling

Where: Maximum Application Rate (lbs a.i./A) = (Maximum seeding rate (lbs seed/A) x application rate[1] (lbs a.i./cwt)) /100 lbs/cwt	
Maximum seeding rate (lb seed/A)[2] =	35 for Ornamental Grasses 30 for Proso Millet 18.9 for Canola (Representative of Oilseed Group 20) 166.7 for Soybeans

[1] on label
[2] from USEPA, 2011

Differences in exposures between ground and aerial applications are not assessed with the current T-REX model. Therefore, terrestrial risk conclusions for the registered uses apply to both ground and aerial exposures resulting from application of metalaxyl and mefenoxam. Due to the large variation in use rates, the resulting dose and dietary-based EECs show a wide variation for metalaxyl and mefenoxam where the highest EECs were produced for application rates to blueberry, bush berries, and raspberry, which are not the highest single or annual application rates, but are presumed to have a short (7 day) application interval. Uncertainties in the terrestrial EECs are primarily associated with a lack of data on pesticide use information, as well as information related to spray interception and subsequent dissipation from foliar surfaces.

[5] USEPA. 2014. Pesticides: Science and Policy. Terrestrial Models. STIR Version 1.0 (Screening Tool for Inhalation Risk). http://www2.epa.gov/pesticide-science-and-assessing-pesticide-risks/models-pesticide-risk-assessment#terrestrial

Subsequent to the publication of the metalaxyl/ mefenoxam preliminary Problem Formulation and issuance of generic data call-in (DCI), EFED developed exposure pathway screening models for inhalation and drinking water which address the potential relevance of these exposure pathways to birds. The Screening Tool for Inhalation Risk (STIR; version 1.0) and Screening Imbibition Program (SIP[6]; version 1.0) evaluate inhalation and exposure through drinking water alone, respectively, as potential pathways of exposure[7]. The results of the SIP results for metalaxyl and mefenoxam are available in **Appendix C,** while STIR inputs and outputs for both chemicals are available in **Appendix D**. The results of analysis using the SIP program indicate that chronic and acute exposure to metalaxyl and mefenoxam through drinking water alone is a potential exposure pathway of concern for mammals and birds, while STIR indicated that exposure to metalaxyl and mefenoxam through droplet or vapor phase inhalation is not likely to be a potential pathway of concern for mammals

[6] USEPA. 2014. Pesticides: Science and Policy. Terrestrial Models. STIR Version 1.0 (Screening Tool for Inhalation Risk). http://www2.epa.gov/pesticide-science-and-assessing-pesticide-risks/models-pesticide-risk-assessment#aquatic

[7] USEPA. 2014. Pesticides: Science and Policy. Terrestrial Models. SIP Version 1.0 (Screening Imbibition Program). http://www2.epa.gov/pesticide-science-and-assessing-pesticide-risks/models-pesticide-risk-assessment#aquatic

Table 4.8. Inputs and Estimated Avian and Mammalian Exposure Concentrations (EECs) to Seed Treatment Uses of Metalaxyl and Mefenoxam

Use	Product application rate (lbs/lb seed)	Application rate (fl oz/CWT and % ai)	Seeding Rate (lbs ai/A)[1]	Maximum Application Rate (lbs ai/A)[2]	Available ai (mg ai/ft^2)	Avian Nagy Dose-Based EECs (mg/kg-bw/day)		
						Small (20 g)	Medium (100 g)	Large (1000 g)
Metalaxyl								
Ornamental grasses	0.00002 lbs/lb seed	(3.4 fl oz/CWT) (0.82 % ai)	35	<0.01	0.00	5	2	1
Proso Millet	0.0014 lbs/lb seed	(17.8 fl oz/CWT) (11.5% ai)	30	0.04	1.03	337	192	86
Mefenoxam								
Oilseed Group 20	0.000075 lbs ai/lb seed	**(0.32 fl oz /CWT) (33.3% ai)***	18.9	<0.01	0.01	19	11	5
Soybeans	0.00015 lbs ai/lb seed	(4.23 fl oz/CWT) (4.8% ai)	166.7	0.02	0.23	33	19	9

[1]USEPA, 2011
[2]Calculated according to the formula outlined in **Table 4.7**

Table 4.9. Dose-based EECs (mg/kg bw) as Food Residues for Birds, Reptiles, and Terrestrial-Phase Amphibians from Labeled Uses of Metalaxyl and Mefenoxam (T-REX v. 1.5.2; June 6, 2013).

Primary Feeding Strategy →	Herbivores and Omnivores												Insectivores			Granivores		
Animal Size →	Small				Med				Large				Small	Med	Large	Small	Med	Large
Dietary Items → / Use(s) ↓	Short Grass	Tall Grass	Broad-leaf Plants	Fruits, pods, seeds, *etc.*	Short Grass	Tall Grass	Broadleaf Plants	Fruits, pods, seeds, *etc.*	Short Grass	Tall Grass	Broadleaf Plants	Fruits, pods, seeds, *etc.*	Arthropods			Seeds, grains, *etc.*		
Metalaxyl																		
Hops	319	146	179	20	182	83	102	11	81	37	46	5	125	72	32	4.4	2.5	1.1
Citrus (Nursery stock)	3257	1493	1832	204	1857	851	1145	116	832	381	467	52	1276	727	326	45	26	12
Mefenoxam																		
Bulb Vegetables	16	8	9	1	9	4	5	1	4	2	2	0.2	6	4	2	0.2	0.1	0.0
Blueberry, Bush Berries, Raspberry	925	424	521	58	528	242	297	33	236	108	133	14	362	207	93	13	7	3

Table 4.10. Mammalian Estimated Exposure Concentrations (EECs) from Seed Treatment Uses of Metalaxyl and Mefenoxam

Use	Product application rate (fl oz/CWT and % ai)	Application rate (fl oz/CWT and % ai)	Seeding Rate (lbs ai/A)[1]	Maximum Application Rate (lbs ai/A)[2]	Available ai (mg ai/ft^2)	Mammalian Nagy Dose-Based EECs (mg/kg-bw/day)		
						Small (20 g)	Medium (100 g)	Large (1000 g)
Metalaxyl								
Ornamental grasses	0.00002 lbs/lb seed	(3.4 fl oz/CWT) (0.82 % ai)	35	<0.01	0.00	4	2	0.62
Proso Millet	0.0014 lbs/lb seed	(17.8 fl oz/CWT) (11.5% ai)	30	0.04	1.03	282	195	45
Mefenoxam								
Oilseed Group 20	0.000075 lbs ai/lb seed	(0.32 fl oz /CWT) (33.3% ai)	18.9	<0.01	0.01	15	10	2
Soybeans	0.00015 lbs ai/lb seed	(4.23 fl oz/CWT) (4.8% ai)	166.7	0.02	0.23	28	19	4

[1]USEPA, 2011
[2]Calculated according to the formula outlined in **Table 4.7**

Table 4.11. Dose-based EECs (mg/kg bw) as Food Residues for Mammals from Labeled Uses of Metalaxyl and Mefenoxam (T-REX v. 1.5.2; June 6, 2013).

Primary Feeding Strategy →	Herbivores and Omnivores												Insectivores			Granivores		
Animal Size →	Small				Med				Large				Small	Med	Large	Small	Med	Large
Dietary Items → / Use(s) ↓	Short Grass	Tall Grass	Broad-leaf Plants	Fruits, pods, seeds, *etc.*	Short Grass	Tall Grass	Broadleaf Plants	Fruits, pods, seeds, *etc.*	Short Grass	Tall Grass	Broadleaf Plants	Fruits, pods, seeds, *etc.*	Arthropods			Seeds, grains, *etc.*		
Metalaxyl																		
Hops	267	122	150	17	184	85	104	12	43	20	24	3	105	72	17	4	3	0.59
Citrus (Nurserystock)	3257	1493	1832	204	1857	851	1045	116	832	381	468	52	1276	727	326	45	26	12
Mefenoxam																		
Bulb Vegetables	14	6	8	1	9	4	5	1	2	1	1	0.1	5	3	1	0	00	0
Raspberry, Blueberry, Bush Berries	775	355	436	48	232	245	301	33	124	57	70	8	303	210	49	11	7	2

Table 4.12. Dietary-based EECs (mg/kg diet) as Food Residues for Birds, Reptiles, Terrestrial-phase Amphibians, and Mammals from Labeled Uses of Metalaxyl and Mefenoxam (T-REX v. 1.5.2; June 6, 2013).

Primary Feeding Strategy →	Herbivores, Omnivores, and Granivores				Insectivores
Dietary Items → / Use(s) ↓	Short Grass	Tall Grass	Broad-leaf Plants	Fruits, pods, seeds, *etc.*	Arthropods
Metalaxyl					
Hops	280	128	157	17.5	109
Citrus (nurserystock)	2860	1311	1609	179	1120
Mefenoxam					
Bulb Vegetables	14	7	8	1	6
Blueberry, Bush Berries, Raspberry	813	372	457	51	318

4.6.2. Terrestrial Invertebrates

The *Guidance for Assessing Pesticide Risks to Bees* (USEPA *et al.*, 2014) provides equations for the calculation of EECs for bees. The Tier I exposure method is intended to account for the major routes of pesticide exposure that are relevant to bees (*i.e.*, through diet and contact). Exposure routes for bees differ based on application type. Bees foraging in a field treated with a pesticide through foliar spray, such as metalaxyl and mefenoxam, could potentially be exposed to the pesticide through direct spray as well through consuming contaminated food. Foraging honey bees may also be exposed to pesticides via consumption of water from surface water, puddles, dew droplet formation on leaves, and guttation fluid; however, the Tier I exposure method does not include quantification of exposures via these routes.

Table 4.13 shows the EECs for a single foliar application of metalaxyl and mefenoxam at the maximum and minimum spray application rate are calculated below.

Adult Contact EEC = xx lbs ai/A * 2.7 µg ai/bee = Y µg ai/bee

Table 4.13. Tier I Contact EEC values for honey bees related to spray applications.

Crop	Single Max. Application Rate (lbs ai/A)	Application Type	Adult Acute Contact EEC (µg ai/bee)
Metalaxyl			
Hops	0.5	Ground	1.35
Avocado, Deciduous Fruit Trees (Unspecified), Stone Fruits, Tree Nuts	4.1	Aerial/Ground	11.07
Mefenoxam			
Bulb Vegetables	0.0656	Ground	0.177
Citrus, Deciduous Fruit Trees (Unspecified)	2	Ground	5.4

4.6.3. Terrestrial Plants

EECs for terrestrial plants were calculated using TERRPLANT v.1.2.2 and inputs are detailed in **Appendix G**. The highest or summary inputs are presented below, while a full list of terrestrial plant EECs are available in **Appendix H.** Resulting upper and lower bound exposure estimates to terrestrial and semi-aquatic (wetland) plants are in **Table 4.14**. EECs are based on the maximum single application rate for terrestrial uses, solubility, and spray drift fraction.

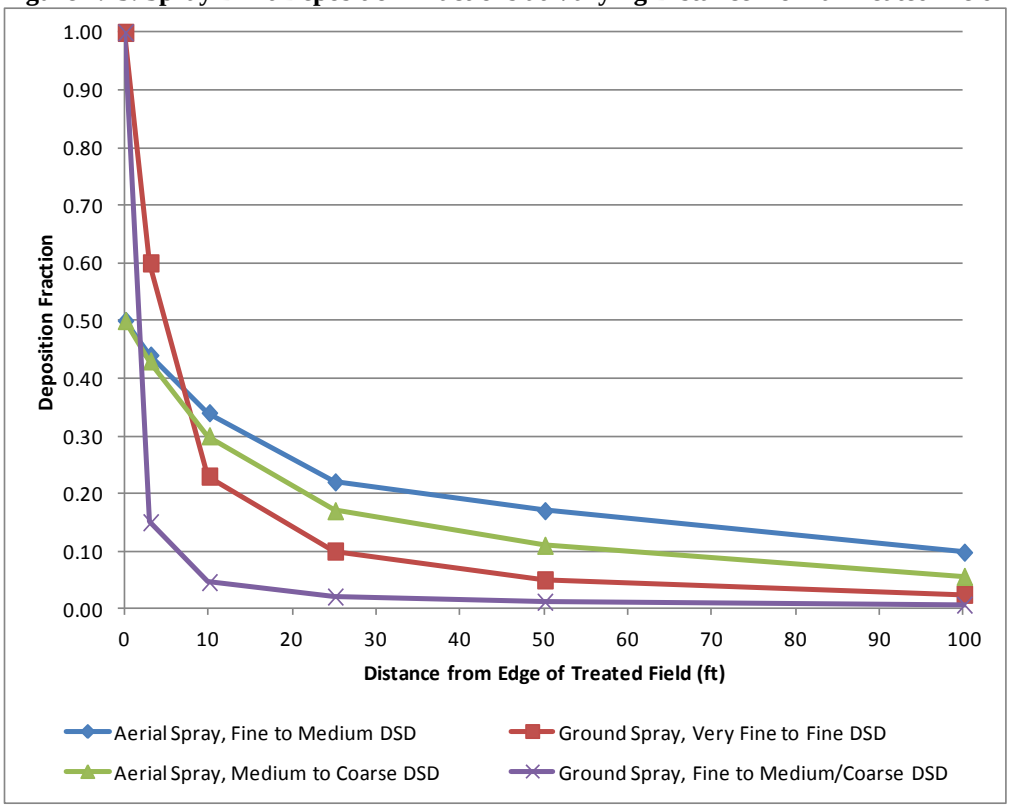
Table 4.14. Calculated EECs for Terrestrial and Semi-Aquatic Plants near Metalaxyl and Mefenoxam Terrestrial Uses Areas

Crop	Single Max. Application Rate (lbs ai/A)	Application Type	Spray Drift Only	Runoff and Spray Drift (Dry Areas)	Runoff and Spray Drift (Semi-Aquatic Areas)
Metalaxyl					
Hops	0.5	Ground	0.0005	0.003	0.0255
Citrus (nursery stock)	10.2	Ground	0.102	0.612	5.202
Mefenoxam					
Bulb Vegetables	0.0656	Ground	0.0006	0.0036	0.0306
Citrus	4	Aerial	0.1	0.2	1.1

4.7. Spray Drift Transport

Exposure via spray drift was assessed using AgDRIFT v2.1.1. Spray drift deposition as a fraction of the on-field application rate varies by distance from the field and by droplet size (**Figure 4.15**). The AgDRIFT Tier 1 model estimates deposition up to 1,000 ft from a treated field. **Figure 4.15** depicts spray drift deposition up to 100 ft for maximum resolution. Spray drift exposure can impact both terrestrial and aquatic taxa.

Figure 4.15. Spray Drift Deposition Fractions at Varying Distance from a Treated Field



DSD = Droplet Size Distribution

5. Effects Analysis

A search of the ECOTOXicology database on June 30, 2016 yielded no suitable studies with more sensitive endpoints than the registrant-submitted guideline studies described below.

Summaries of the most sensitive aquatic and terrestrial toxicity data for metalaxyl and mefenoxam are provided **Table 5.1** and **Table 5.2**. A full list of toxicity studies considered can be found in **Appendix I**. Toxicity endpoints for various formulated products are found in **Table 5.3.**

Metalaxyl and mefenoxam will be assessed separately, using their respective datasets. Where data gaps exist for one chemical, available data from the other chemical will be used to estimate risk where possible. For mefenoxam, this includes chronic mammalian data, chronic freshwater fish data and chronic freshwater invertebrate data. As shown in **Table 5.3,** some end use products (TEP) may be more toxic to aquatic species than the technical product.

5.1. Terrestrial Toxicity

5.1.1. Metalaxyl

Table 5.1 presents the most sensitive metalaxyl endpoints for terrestrial taxa that are used in this risk assessment. Acute exposure of metalaxyl technical to rats was shown to be slightly toxic (LD_{50}= 669 mg ai/kg-bw). Sublethal effects recorded in surviving individuals were hypoactivity, staggered gait, and dyspnea. A chronic, 2-generation reproduction study with rats (MRID 00071600) did not observe any significant effects to reproductive endpoints up to the highest test concentration (NOAEC=1250 mg ai/kg-diet). Histopathological changes in the livers of female pups resulting in increased liver weight was observed during the study. Four-hour inhalation exposure (MRID 49140708) did not result in any mortality or signs of toxicity.

Acute exposure of metalaxyl to representative avian species ranged from slightly to moderately toxic. The most sensitive species was the passerine species, canary (*Serinus canaria*), with an LD_{50} of 694 mg ai/kg (MRID 49311101). Clinical signs of toxicity observed during the study included mortality, loss of coordination, ruffled appearance, lethargy, lower limb weakness, prostrate posture, loss of righting reflex, depression and convulsions. 8-day dietary exposure of metalaxyl to birds was practically non-toxic. In the case of Japanese quail (00063988/ 00234439), mallard ducks (MRID 00234439) and bobwhite quails (MRID 00234439), no signs of toxicity were observed up to the maximum dosage of 10,000 mg/kg-diet.

Effects from chronic exposure to bobwhite quails (MRID 44720901) and mallard ducks (MRID 44720902) were initially assessed up to an equivalent field application rate of 3.96 lbs ai/A (900 mg ai/kg-diet). No toxicological effects of chronic exposure were observed at this exposure concentration in either species. To reduce uncertainty, follow-up avian reproduction limit tests were conducted on bobwhite quails (MRID 49115801) and mallard ducks (MRID 49115901) at a single test concentration of 1421 mg ai/kg-diet, which is equivalent to a field application rate of 6 lbs ai/A. In the limit test with bobwhite quails, a significant 8.2% reduction in 14-d survivor weight was observed at the 1421 mg ai/kg-diet test concentration. As a result, the NOAEC of 900 mg ai/kg-diet is used to assess chronic risk to birds in this assessment.

Metalaxyl is practically non-toxic to honeybees on an acute contact basis, however the chemical purity of the test substance was not reported in this study (MRID 40276701). As a result, there is some uncertainty about the true magnitude of the contact toxicity of metalaxyl to honeybees. Submission of an additional study would likely confirm a low toxicity based on a comparison with the toxicity endpoint for mefenoxam. Acute and chronic oral toxicity data for adult honeybees, as well as acute and chronic honeybee larval toxicity data for metalaxyl have not yet been submitted to the Agency.

Seedling emergence (MRID 49024016) and vegetative vigor (MRID 49024015) toxicity studies were submitted for metalaxyl. Significant effects observed in the seedling emergence and growth study observed a reduction in seedling dry weight in onion (monocot EC_{25}=1.6 lbs ai/A), and a reduction in survival in lettuce (dicot EC_{25}=1.97 lbs ai/A). No significant effects on monocot species were observed for vegetative vigor up to the maximum test concentration (monocot EC_{25}>4.1 lbs ai/A). The only effects observed in dicots were slight but statistically significant effects were observed on dry weight in the dicot species cabbage and soybean (EC_{25} >4.1 lb ai/A; NOAEC=2.0 lbs ai/A). The seedling emergence and vegetative vigor tests with metalaxyl were not carried out up to the highest application rate of 10.2 lbs ai/A for citrus nurserystock. This results in uncertainties about the risks of contact with spray drift, as the vegetative vigor

endpoints for monocots and dicots are non-definitive (monocot and dicot EC_{25}>4.1 lbs ai/A). Effects were observed in monocots and dicots below the highest test concentration in the seedling emergence and growth studies, so risk from runoff can be assessed.

5.1.2. Mefenoxam

Table 5.1 presents the most sensitive mefenoxam endpoints for terrestrial taxa that are used in this risk assessment mefenoxam was slightly toxic to rats (LD_{50}=1269 mg/kg-bw; MRID 43800383) on acute exposure basis. Sublethal effects observed during the experiment included hypoactivity, staggered gait and hunched posture. No reproductive effects were observed up to the highest test concentration in the chronic 2-generation toxicity study with metalaxyl (MRID 00071600) and this endpoint will be used to assess risk to mefenoxam (NOAEC=1250 mg ai/kg-diet), as a comparison of the acute toxicity data indicate that this endpoint is protective of risk from mefenoxam exposure. No effects were observed during inhalation exposure up to the maximum concentration of 2.29 mg/L (MRID 43800385)

Mefenoxam is slightly toxic to bobwhite quails on an acute basis (LD_{50}=981 mg ai/kg-bw; MRID 43875302), while 8-day subacute dietary exposure was to bobwhite quail is at most slightly toxic (LC_{50}> 4830 mg/kg-diet). EFED guidelines currently require an oral toxicity study with a passerine species. Passerine species have higher metabolic rates due to their smaller sizes than either waterfowl or upland game bird species and because they may utilize different metabolic pathways, they may be more or less sensitive to mefenoxam. As a result, the more sensitive canary endpoint for metalaxyl will be used to assess the acute risk of mefenoxam exposure to birds. Effects of chronic exposure to bobwhite quails (MRID 44720901) and mallard ducks (MRID 44720902) were assessed at rates equivalent to a field application rate of 3.96 lbs ai/A, which is equivalent to 900 mg ai/kg-diet. This is consistent with the NOAEC value used for metalaxyl. No toxicological effects of chronic exposure were observed up to the maximum rate for either species.

No adverse effects were observed in a contact toxicity test with honeybees (MRID 43875308) up to the highest concentration tested (LD_{50}>25 µg ai/ bee). As a result, mefenoxam is practically non-toxic to bees on an acute contact basis. Acute and chronic oral toxicity data for adult honeybees, as well as acute and chronic honeybee larval toxicity data for mefenoxam have not yet been submitted to the Agency.

A Tier I seedling emergence study (MRID 49049807) with terrestrial plants observed significant inhibitions in biomass for corn (27%), oat (14%), onion (22%) and radish (10%) seedlings. A Tier II study with these four species found no inhibition up to the highest test concentration of 3 lbs ai/A for corn, oat and radish. The results for onion reported higher than acceptable variation for onion height and weight at all test concentrations. As a result, endpoints for onion are not used in this risk assessment and toxicity endpoints for metalaxyl are used to assess risk to monocots from mefenoxam exposure. For dicot species, no effects were observed up to the highest test concentration (EC_{25}>3.06 lb ai/A). A Tier I vegetative vigor study (MRID 49049808) identified significant shoot length inhibition in oilseed rape and radish of 8 and 13%, respectively. A Tier II study with oilseed rape and radish calculated an EC_{25} of 2.76 lb ai/A and a NOAEC of 0.76 lb ai/A based on biomass weight inhibition in oilseed rape. The endpoints for

monocot species are EC_{25}>2.73 and NOAEC=2.73 lb ai/A and the most sensitive species could not be determined due to lack of toxicity.

Table 5.1. A Summary of the Most Sensitive Toxicity Endpoints Selected for Risk Estimation for Terrestrial Organisms Exposed to Metalaxyl and Mefenoxam.

Taxa	Test Type	Most Sensitive Species	Endpoint	MRID	Test Material	Toxicity Category
Birds, terrestrial-phase amphibians and reptiles**	850.2100 Acute oral	Canary	LD_{50}=694 mg ai/kg-bw	49311101	Metalaxyl	Slightly Toxic
	850.2100: Acute oral	Bobwhite Quail	LD_{50}=981 mg ai/kg-diet	43875302	Mefenoxam	Slightly Toxic
	850.2200 Sub-acute dietary	Bobwhite	LC_{50}>10,000 mg/kg-diet	00234439	Metalaxyl	Practically Non-Toxic
	850.2200: Sub-acute dietary	Bobwhite Quail	LC_{50} > 4830 mg/kg-diet	43875303	Mefenoxam	Slightly toxic
	850.2300 Avian Reproduction	Bobwhite	NOAEC=900 mg/kg-diet	44755001	Metalaxyl	--
	850.2300: Avian Reproduction	Northern Bobwhite/ Mallard Duck	NOAEC=900 mg ai/kg-diet	44720901 44720902	Mefenoxam	--
Mammals	870.1100 Acute oral	Rat	LD_{50}= 669 mg/kg-bw	00063990	Metalaxyl	Slightly Toxic
	870.1100: Acute oral	Rat	LD_{50}=1269 mg/kg-bw	43800383	Mefenoxam	Slightly Toxic
	870.3800 Chronic	Rat	NOAEC=1250 mg/kg-diet	00071600	Metalaxyl	--
	870.1300 Acute Inhalation	Rat	LC_{50}>4.0 mg/L	49140708	Metalaxyl	--
	870.1300: Acute Inhalation	Rat	LC_{50}>2.29 mg/L	43800385	Mefenoxam	--
Bees	850.3020 Acute contact	Honeybee	LD_{50}>100 µg/bee	40276701	Metalaxyl	Practically Non-Toxic
	850.3020: Acute contact	Honey bee	LD_{50}>25 µg ai/ bee	43875308	Mefenoxam	Practically Non-Toxic
Terrestrial and wetland plants - monocots	850.4100 Seedling Emergence	Monocot: Onion	EC_{25}=1.6 lbs ai/A NOAEC= 1.0 lbs ai/A	49024016	Metalaxyl	--
		Dicot: Lettuce	EC_{25}= 1.97 lbs ai/A NOAEC= 0.51 lbs ai/A	49024016	Metalaxyl	--
	850.4100: Seedling Emergence	Monocot:	EC_{25}=1.6 lbs ai/A NOAEC= 1.0 lbs ai/A	49024016 (metalaxyl)	Mefenoxam	--
		Dicot: None	EC_{25}>3.06 lb ai/A NOAEC=3.06 lb ai/A	49049807	Mefenoxam	--

	850.4150 Vegetative Vigor	Monocot: None	EC_{25}>4.1 lbs ai/A NOAEC= 4.1 lbs ai/A	49024015	Metalaxyl	--
		Dicot: cabbage and soybean	EC_{25}>4.1 lbs ai/A NOAEC= 2.0 lbs ai/A	49024015	Metalaxyl	--
	850.4150: Vegetative Vigor	Monocot: None	EC_{25}>2.73 lb ai/A NOAEC= 2.73 lb ai/A	49049808	Mefenoxam	--
		Dicot: Oilseed rape	EC_{25}=2.76 lb ai/A NOAEC=0.76 lb ai/A	49049808	Mefenoxam	--

** Birds are surrogates for terrestrial-phase amphibians and reptiles.

5.2. Aquatic Toxicity

5.2.1. Metalaxyl

Table 5.2 presents the most sensitive metalaxyl endpoints for aquatic species that are used in this risk assessment. Metalaxyl is practically non-toxic to freshwater fish. The rainbow trout is the most sensitive freshwater fish species on an acute basis (LC_{50}= 130 mg/L; MRID 00100447). Acute toxicity of metalaxyl to estuarine/marine fish is uncertain because the available study (MRID 49024003) has not been reviewed by the Agency. Chronic exposure to the fathead minnow (MRID 00071308) did not result in any toxicity effects up to the maximum concentration of 9.1 mg ai/L.

Metalaxyl is slightly toxic to practically nontoxic to freshwater invertebrates on an acute basis. *Daphnia magna* is the most sensitive species (LC_{50}=28 mg ai/L; 00100448). Chronic exposure of metalaxyl to *Daphnia magna* resulted in statistically-significant reductions in offspring per female and increased mortality (NOAEC=1.2 mg a/L; 00071307). Metalaxyl is slightly to moderately toxic to eastern oyster (EC_{50}=17.6 mg ai/L; MRID 49145101) and slightly toxic to mysid shrimp (LC_{50}= 25.7 mg ai/L; MRID 41288103) on an acute exposure basis. Eastern oyster is the most sensitive estuarine/marine invertebrate species. A study with eastern oyster (MRID 41288101) reported a more sensitive endpoint (EC_{50}=4.6 mg ai/L), however, due to analytical problems reported in the study, and lack of raw data, an in-house verification of the statistical re-analysis of the results could not be performed for this study, leading to uncertainties which resulted in the qualitative use of this study in this risk assessment. Chronic exposure to mysid shrimp (MRID 49116001) resulted in reproductive effects that included a statistically significant 47% reduction in offspring production and 32% increase in the time to first brood (NOAEC=0.74 mg ai/L).

The most sensitive aquatic plant species to metalaxyl exposure was the vascular plant species, duckweed *Lemna gibba* (EC_{50}=85 mg/L; MRID 00148448). A NOAEC value was not determined in this study because a statistically significant reduction in the number of fronds was

observed at all test concentrations. Nonvascular aquatic plant studies were submitted for green algae, freshwater diatom, cyanobacteria, and the marine diatom. The most sensitive nonvascular aquatic plant is green algae (MRID 49024012), where significant inhibitions in area under the growth curve were observed.

5.2.2. Mefenoxam

Table 5.2 presents the most sensitive mefenoxam endpoints for aquatic taxa that are used in this risk assessment. Mefenoxam is practically non-toxic based on a lack of toxicity effects observed for rainbow trout (LC_{50}>121 mg ai/L; MRID 43875304) and fathead minnow (LC_{50}>110 mg ai/L; 49049803). No studies are available that assess the effects of chronic exposure of mefenoxam to these species. Chronic risk to freshwater and estuarine fish will be estimated using the chronic metalaxyl endpoint for fathead minnows (NOAEC= 9.1 mg ai/L; MRID 49049803). An unreviewed study with estuarine/marine fish indicates that mefenoxam is practically non-toxic to estuarine/marine fish on an acute basis, based on sheepshead minnow endpoints (LC_{50}>125 mg ai/L; 49024011). No data were available that characterized the chronic toxicity to estuarine/marine fish. Estimating a chronic endpoint using an Acute to Chronic Ratio (ACR) is not appropriate in this case because of the non-definitive nature of the freshwater and estuarine/marine endpoints. In the absence of chronic toxicity data, endpoints will be approximated using the chronic toxicity for freshwater fish (NOAEC=9.1 mg ai/L; MRID 00071308).

Mefenoxam is slightly toxic to freshwater invertebrates on an acute basis based on endpoints for *Daphnia magna* (LC_{50}=53.8 mg ai/L; MRID 49156001). Chronic toxicity to freshwater invertebrates is uncertain because no studies have been submitted, so the metalaxyl (NOAEC= 1.2 mg ai/L; MRID 00071307) endpoint will be used to estimate risk. Mefenoxam is moderately toxic to estuarine/marine invertebrate species based on endpoints for the eastern oyster (EC_{50}= 9.7 mg ai/L; MRID 43875306). Acute endpoints for the mysid shrimp are not available for mefenoxam. No toxicity effects were observed during a chronic toxicity test with the mysid shrimp up to the highest concentration (NOAEC=9.7 mg ai/L; MRID 49156002). (The author noted that the same endpoint was calculated for acute exposure to the eastern oyster and chronic exposure to mysid shrimp. This was acknowledged and the accuracy of the endpoints was verified.)

Based on the aquatic plants that were tested, the most sensitive species is the vascular species, duckweed *Lemna gibba* (EC_{50} = 77 mg ai/L; MRID 43875307). This was consistent with the most sensitive aquatic plant species to metalaxyl exposure. Toxicity effects observed in this study were a significant reduction in frond number and dry weight relative to controls.

Table 5.2. A Summary of the Most Sensitive Toxicity Endpoints for Aquatic Organisms Exposed to Metalaxyl and Mefenoxam

Taxa	Test Type	Most Sensitive Species	Endpoint	MRID	Test Material	Toxicity Category
Freshwater Fish	850.1075: Acute	Rainbow trout	LC_{50}=130 mg ai/L	00100447	Metalaxyl	Practically Non-Toxic

	850.1075: Acute	Fathead Minnow	LC_{50}>110 mg ai/L	49049803	Mefenoxam	Practically Non-Toxic
	850.1400; Early Life-Stage	Fathead Minnow	NOAEC=9.1 mg ai/L	00071308	Metalaxyl	--
Estuarine Marine Fish	850.1075: Acute	Sheepshead minnow	LC_{50}>124 mg ai/L	49024003	Metalaxyl	Practically Non-Toxic
	850.1075: Acute	Sheepshead minnow	LC_{50}>95 mg ai/L	49049805	Mefenoxam	Practically Non-Toxic
	850.1400: Early Life-Stage	None	NA	NA	Metalaxyl	--
Freshwater Invertebrates	850.1010: Acute	Daphnia	LC_{50}= 28 mg ai/L	00100448	Metalaxyl	Slightly Toxic
	850.1010: Acute	Daphnia	LC_{50}= 53.8 mg ai/L	49156001	Mefenoxam	--
	850.1300: Life-Cycle Toxicity	Daphnia	NOAEC=1.2 mg ai/L	00071307	Metalaxyl	--
Estuarine/marine Invertebrates	850.1025: Acute Toxicity	Eastern Oyster	EC_{50}= 17.6 mg ai/L	49145101	Metalaxyl	Slightly Toxic
	850.1025: Acute Toxicity	Eastern Oyster	EC_{50}= 9.7 mg ai/L	43875306	Mefenoxam	Moderately Toxic
	850.1350: Life-Cycle Toxicity	Mysid	NOAEC= 0.74 mg ai/L	49116001	Metalaxyl	--
	850.1350: Life-Cycle Toxicity	Mysid	NOAEC= 9.7 mg ai/L	49156002	Mefenoxam	--
Aquatic Plant Toxicity	850.4400; Aquatic Vascular Plant	Duckweed	EC_{50}=85 mg ai/L NOAEC=56.5 mg ai/L	00148448	Metalaxyl	--
	850.4400: Aquatic Vascular Plant	Duckweed	EC_{50} = 77 mg ai/L NOAEC<3.0 mg ai/L	43875307	Mefenoxam	--
	850.4500: Toxicity Test with Freshwater Alga	Green Algae	EC_{50}=140 mg/L NOAEC= 100 mg/L	00148448/ 00257606	Metalaxyl	--
	850.4500: Toxicity Test with Freshwater Alga	Green Algae	LC_{50}=20.3 mg ai/L NOAEC=6.2 mg ai/L	49024012	Mefenoxam	--

5.3. Additional Discussion of Toxicity Data

1.1.1. Degradate toxicity

Two major degradates (>10% formation of applied radioactivity), CGA-62826 and CGA-119857, were reported in environmental fate studies for metalaxyl/mefenoxam. No data are available which assess the toxicity of these degradation products to aquatic or terrestrial taxa. In the absence of data, the toxicity of these degradates is conservatively presumed to be equal to that of the parent. Use of ECOSAR to predict effects of acute exposure to aquatic organisms is not appropriate in this case because of the acid moiety of the degradation products.

5.3.1. TEP Toxicity

As requested in the Problem Formulation, several acute toxicity studies with fish and invertebrate species were conducted with technical end use products (TEP) of metalaxyl and mefenoxam. The results of these studies are shown in **Table 5.3.**

Studies with metalaxyl TEPs Ridomil 2E-G (27.9% ai), Ridomil 2E (25.2% ai), and Sebring 480 FS (44.0% ai) were conducted with freshwater fish, freshwater invertebrates and estuarine/marine invertebrates. These endpoints show that metalaxyl, when applied as part of the formulated product Ridomil 2E-G, may exhibit enhanced toxicity to freshwater fish and freshwater invertebrates relative to metalaxyl technical. These studies also show that metalaxyl, when applied as part of Ridomil 2E, may also exhibit enhanced toxicity to estuarine/marine invertebrates. Studies evaluating the toxicity of the formulated product, Sebring 480 FS, are currently under review, but preliminary results suggest that metalaxyl applied as part of this formulated product does not exhibit enhanced toxicity to freshwater fish, freshwater invertebrates, and estuarine/marine invertebrates relative to the technical product.

Acute toxicity studies with Ridomil Gold SL, a formulated product containing mefenoxam (45.3% ai), were conducted with estuarine/marine fish, and two species of estuarine/marine invertebrates. The results of these studies suggest that mefenoxam applied as part of this formulated product may exhibit enhanced toxicity to estuarine/marine fish compared to the technical product, while toxicity to mollusks may be decreased.

The acute aquatic risk assessment for exposure to the TEP will be based on exposure only from spray drift only, not from runoff, since the inert ingredients cannot be assumed to exhibit the same runoff characteristics as metalaxyl/ mefenoxam. The Agency will review the confidential statement of ingredients of these formulations to ensure these are representative of metalaxyl and mefenoxam registered products.

Table 5.3. A Comparison of the Toxicities of Metalaxyl and Mefenoxam TGAI and TEPs

Taxa	Species	Metalaxyl TGAI	Metalaxyl TEP (27.9% ai) Ridomil 2E-G	Metalaxyl (25% ai) Ridomil 2E	Metalaxyl (44% ai) SEBRING™ 480 FS
Metalaxyl					
Freshwater Fish	**Bluegill Sunfish** *Lepomis macrochirus*	LC_{50}=139 mg ai/L 00071302	LC_{50}=7.53 mg ai/L 00071301	--	LC_{50}>125 mg ai/L 49024001 (In Review)
Freshwater Fish	**Rainbow Trout** *Oncorhynchus mykiss*	LC_{50}=130 mg/L 00100447	LC_{50}=5.13 mg ai/L 00072396	-	LC_{50}>123 mg/L 49024006 (In Review)
Freshwater Fish	**Fathead Minnow** (*Pimephales promelas*)	LC_{50}>123 mg/L 49024002	-	-	LC_{50}>125 mg/L 49024001 (In Review)
Freshwater Fish	**Sheepshead minnow** (*Cyprinodon variegatus*)	LC_{50}>124 mg ai/L 49024003	-	-	LC_{50}>122 mg/L 49024011 (In Review)
Freshwater Invertebrates	**Water Flea** *Daphnia magna*	LC_{50}= 28 mg/L 00100448	LC_{50} =12.5 mg ai/L 00071304	-	EC_{50}>301 mg ai/L 49024004 (In Review)
E/M Invertebrates	**Mysid Shrimp** *Mysidopsis bahia*	LC_{50}= 25.7 mg ai/L 41288103	-	LC_{50}=1.5 mg ai/L 42337501	LC_{50}>122 mg/L 49024010 (In Review)
E/M Invertebrates	**Eastern oyster** *Crassostrea virginica*	EC_{50}= 17.6 mg ai/L 49145101	EC_{50}= 4.44 mg ai/L 42378101	-	-
Taxa	**Species**	**Mefenoxam TGAI**	**Ridomil Gold SL (45.3%)**	**-**	**-**
Mefenoxam					
E/M Fish	**Sheepshead Minnow** *Cyprinodon variegatus*	LC_{50}>95 mg ai/L 49049805	LC_{50}=14.4 mg ai/L 49049804	-	-
E/M Invertebrates	**Eastern Oyster** *Crassostrea virginica*	EC_{50}= 9.7 mg ai/L 43875306	EC_{50}= 12.9 mg ai/L 49049801	-	-
E/M Invertebrates	**Mysid Shrimp** *Americamysis bahia*	--	LC_{50}=7.16 mg ai/L 49049802	-	-

5.4. Incidents

The Ecological Incident Information System or EIIS maintained by the Environmental Fate and Effects Division, and the Avian Incident Monitoring System (AIMS) maintained by the American Bird Conservancy, were searched on February 26, 2015 and 6 incidents were recorded in the EIIS database for metalaxyl and 9 incidents in the EIIS database for mefenoxam. A summary of these incidents is available in **Appendix E.** The AIMS database reported one incident with metalaxyl in Arlington, VA involving a single mortality of an eastern bluebird. Metalaxyl was listed as an unlikely cause of the mortality, as several chemicals were involved in the incident.

In addition to the incidents recorded in EIIS and AIMS, additional incidents are reported to the Agency in aggregated form. Pesticide registrants report certain types of incidents to the Agency as aggregate counts of incidents occurring per product per quarter. Ecological incidents reported in aggregate reports include those categorized as 'minor fish and wildlife' (W-B), 'minor plant' (P-B), and 'other non-target' (ONT) incidents. 'Other non-target' incidents include reports of adverse effects to insects and other terrestrial invertebrates. A search of this database identified incident summaries that were submitted for metalaxyl. These summaries contained a total of 54 incidents. Four of these incidents were categorized as minor wildlife and one as minor plant. There was one aggregated incident summary submitted for mefenoxam, which contained two minor incidents categorized as minor wildlife.

5.5. Endocrine Disruptor Screening Program

As required by FIFRA and the Federal Food, Drug, and Cosmetic Act (FFDCA), EPA reviews numerous studies to assess potential adverse outcomes from exposure to chemicals. Collectively, these studies include acute, subchronic and chronic toxicity, including assessments of carcinogenicity, neurotoxicity, developmental, reproductive, and general or systemic toxicity. These studies include endpoints which may be susceptible to endocrine influence, including effects on endocrine target organ histopathology, organ weights, estrus cyclicity, sexual maturation, fertility, pregnancy rates, reproductive loss, and sex ratios in offspring. For ecological hazard assessments, EPA evaluates acute tests and chronic studies that assess growth, developmental and reproductive effects in different taxonomic groups. As part of the Preliminary Problem Formulation for Registration Review, EPA reviewed these data and selected the most sensitive endpoints for relevant risk assessment scenarios from the existing hazard database. As required by FFDCA section 408(p), metalaxyl and mefenoxam are subject to the endocrine screening part of the Endocrine Disruptor Screening Program (EDSP).

EPA has developed the EDSP to determine whether certain substances (including pesticide active and other ingredients) may have an effect in humans or wildlife similar to an effect produced by a "naturally occurring estrogen, or other such endocrine effects as the Administrator may designate." The EDSP employs a two-tiered approach to making the statutorily required determinations. Tier 1 consists of a battery of 11 screening assays to identify the potential of a chemical substance to interact with the estrogen, androgen, or thyroid (E, A, or T) hormonal systems. Chemicals that go through Tier 1 screening and are found to have the potential to interact with E, A, or T hormonal systems will proceed to the next stage of the EDSP where EPA

will determine which, if any, of the Tier 2 tests are necessary based on the available data. Tier 2 testing is designed to identify any adverse endocrine-related effects caused by the substance, and establish a dose-response relationship between the dose and the E, A, or T effect.

Under FFDCA section 408(p), the Agency must screen all pesticide chemicals. Between October 2009 and February 2010, EPA issued test orders/data call-ins for the first group of 67 chemicals, which contains 58 pesticide active ingredients and 9 inert ingredients. A second list of chemicals identified for EDSP screening was published on June 14, 2013[8] and includes some pesticides scheduled for registration review and chemicals found in water. Neither of these lists should be construed as a list of known or likely endocrine disruptors. Metalaxyl is on list 1 for which EPA has received all of the required Tier 1 assay data. The Agency has reviewed all of the assay data received for the appropriate List 1 chemicals and the conclusions of those reviews are available in the chemical-specific public dockets[9]. For further information on the status of the EDSP, the policies and procedures, the lists of chemicals, future lists, the test guidelines and Tier 1 screening battery, please visit our website[10].

6. Risk Characterization

For this preliminary risk assessment (PRA) of metalaxyl and mefenoxam, the deterministic RQ method was used to provide a metric of potential risks. The RQ is a comparison of exposure estimates to toxicity endpoints (*i.e.*, RQ = EEC/toxicity endpoint). The resulting RQs are compared to the Agency's risk levels of concern (LOC), which are the Agency's interpretive policy such that when acute or chronic risk LOCs are exceeded, the need for regulatory action may be considered. These criteria are used to indicate when the use of a pesticide, as directed on the label, has the potential to cause adverse effects to non-target organisms. For acute risk concerns to terrestrial mammals and birds, the LOCs for listed and non-listed species from acute exposure are 0.1 and 0.5, respectively. The chronic mammalian, avian, and terrestrial plant LOC is 1.0 for listed and non-listed species. The LOC for terrestrial invertebrates is 0.4. For listed aquatic animals, the acute LOC is 0.05 for listed species and 0.1 for non-listed species. The chronic LOC for aquatic species is 1.0 for listed and non-listed species. In the following sections, RQs are generated and risks are discussed. This discussion includes consideration of additional data and lines of evidence.

In the following sections, RQ values are calculated for aquatic and terrestrial organisms (**Tables 6.1-6.14**). If multiple PWC scenarios are available to estimate aquatic exposure resulting from a registered use (i.e. CA citrus and FL citrus), the scenario resulting in the highest RQ values is reported in **Tables 6.1-6.3**. All aquatic and terrestrial RQ values that exceed LOCs are shown in the tables below. RQ values that are well below the LOC are not shown in the table to increase clarity.

[8] See http://www.regulations.gov/#!documentDetail;D=EPA-HQ-OPPT-2009-0477-0074 for the final second list of chemicals.
[9] https://www.epa.gov/sites/production/files/2015-06/documents/metalaxyl-113501_2015-06-29_txr0057181.pdf
[10] Available: http://www.epa.gov/endo/

6.1. Aquatic Species

6.1.1. Fish

Metalaxyl

As shown in **Table 6.1,** no acute or chronic risk concerns to freshwater fish were identified for existing uses of metalaxyl. The highest acute RQ is 0.01, which is below the acute aquatic LOC of 0.5, while the highest chronic RQ is 0.10, well below the chronic LOC of 1.0.

RQs for acute exposure of metalaxyl to estuarine/marine fish were not calculated because the endpoint is non-definitive (metalaxyl LC_{50}>124 mg ai/L), and no effects were observed at the highest test concentration. In order to gain a better understanding of how the highest metalaxyl EECs relate to the toxicity data currently available for acute exposure, ratio of the highest EECs (highest peak metalaxyl EEC of 0.852 mg ai/L, based on exposure to cranberry bog water) and the toxicity endpoint were calculated using the conservative assumption that the highest value tested represents the toxicity endpoint. In this exercise, the ratios calculated are all <0.05. This comparison indicates that there are no risk concerns for acute exposure to estuarine/marine fish from the uses on metalaxyl.

Mefenoxam

Existing uses

Acute RQs for freshwater or estuarine/marine fish exposure to mefenoxam were not calculated because the acute endpoints are non-definitive (fathead minnow LC_{50}>110 mg ai/L; sheepshead minnow; LC_{50}>95 mg ai/L). Instead, ratios of the highest peak EECs (0.801 mg ai/L, based on application to cranberry bog-water) and the non-definitive endpoints were calculated using the conservative assumption that the highest values tested represent the toxicity endpoint, which are conservative assumptions, as no toxicity effects were observed at the highest test concentrations. In this exercise, the ratios calculated are <0.05. As a result, there are no acute risk concerns for freshwater or estuarine/marine fish based on the registered uses of mefenoxam.

The highest chronic freshwater fish RQ for mefenoxam is 0.09, calculated based on the EEC for cranberry paddy water, was well below the chronic LOC (=1.0) so no risk concerns to freshwater fish from chronic exposure were identified. No data for chronic exposure to estuarine/marine fish are available for mefenoxam. In the absence of data, the chronic toxicity endpoint for metalaxyl exposure to freshwater fish (NOAEC = 9.1 mg ai/L) will be used to estimate risk to estuarine/marine fish from chronic exposure to mefenoxam. As no chronic risk concerns were identified for freshwater fish, and no effects were observed at the highest test concentration of the freshwater fish study, it is presumed that no chronic risk concerns exist for estuarine/marine fish. Risk conclusions for freshwater fish is likely protective of risk to estuarine/marine fish, as estuarine/marine fish would need to be at least 10 times more sensitive than freshwater fish to trigger a risk concern.

Proposed Crop Group Conversion

No risks to fish are expected from the proposed crop group conversion. Due to the low application rate (<0.01 lbs ai/A), the risk conclusions for foliar and ground spray are protective of this proposed crop group conversion.

Table 6.1. Acute and Fish Risk Quotients for Freshwater Fish Exposed to Metalaxyl and Mefenoxam

Use	Scenario	Freshwater Fish RQs	
		Acute	Chronic
Metalaxyl			
		LC_{50} = 130 mg ai/L	**NOAEC = 9.1 mg ai/L**
Citrus Trees	FL Citrus	0.01	0.10
Citrus Nursery stock	FL Citrus	0.01	0.09
Fruits	MI Cherry	0.01	0.10
Cranberry[1]	NA	0.01	0.18
Mefenoxam			
		LC_{50}>110 mg ai/L	**NOAEC = 9.1 mg ai/L (Metalaxyl)**
Citrus	FL Citrus	NC	0.05
Fruits	MI Cherry	NC	0.04
Cranberry[1]	NA	NC	0.09

NC= Endpoints were not calculated because endpoints were non-definitive
Bolded values meet or exceed the LOC for non-listed species of 0.5 for acute risk or 1.0 for chronic risk.
Shaded values meet or exceed the LOC for listed species of 0.05 for acute risk or 1.0 for chronic risk.
[1]Based on undiluted bog-water

6.1.2. Aquatic Invertebrates

6.1.2.1. Water Column Invertebrates

Metalaxyl

RQs for acute and chronic exposure of metalaxyl to freshwater and estuarine/marine invertebrates at the highest application rates are shown in **Table 6.2.** RQ values are at or below the LOCs for acute (=0.05) and chronic (=1.0) exposure to freshwater invertebrates for all uses except for the EEC for undiluted cranberry bog water, where the acute RQ exceeded the LOC for listed freshwater fish and the chronic RQ (1.39) exceed the LOC (=1) for chronic freshwater fish. For acute exposure to estuarine/marine invertebrates, the RQ of 0.09, for exposure to untreated cranberry bog water, is the only RQ that exceeds the LOC for listed aquatic species (=0.05), although RQs for citrus and deciduous fruit trees are equal to the LOC for listed aquatic species. Chronic risk concerns to listed and non-listed estuarine/marine invertebrates were identified for application to citrus trees in Florida, application to citrus nursery stock in Florida, application to cherries in Michigan and exposure to untreated cranberry bog water. The highest chronic RQ, based on undiluted cranberry bog water is 2.21.

Mefenoxam

Existing Uses

RQ values for the highest spray application rates did not exceed acute or chronic LOCs for listed or non-listed aquatic species, as shown in **Table 6.2**. The acute RQ of 0.08 for undiluted cranberry bog water exceeded the LOC (=0.05) for acute exposure to listed aquatic species. As a result, risk concerns for acute exposure to estuarine/marine invertebrates exists only for undiluted water from cranberry bogs.

Proposed Crop Group Conversion

No risks to aquatic invertebrates are expected from the proposed crop group conversion. Due to the low application rate (<0.01 lbs ai/A), the risk conclusions for foliar and ground spray are protective of this proposed crop group conversion.

Table 6.2. Acute and Chronic Aquatic Water Column Invertebrate Risk Quotients for Metalaxyl and Mefenoxam

Use Sites	Scenario	Freshwater		Estuarine/Marine	
		Acute	Chronic	Acute	Chronic
Metalaxyl					
		LC_{50} = 28 mg ai/L	**NOAEC = 1.2 mg ai/L**	**LC_{50} = 17.6 mg ai/L**	**NOAEC = 0.74 mg ai/L**
Fruits	MI Cherry	0.03	0.80	0.05	**1.29**
Citrus (Nursery stock)	FL Citrus	0.03	0.66	0.05	**1.27**
Citrus (Trees)-aerial	FL Citrus	0.03	0.74	0.05	**1.21**
Citrus (Trees)-ground	FL Citrus	0.03	0.79	0.05	**1.07**
Cranberry[1]	NA	0.06	**1.39**	0.09	**2.21**
Mefenoxam					
		LC_{50} = 53.8 mg ai/L	**NOAEC = 1.2 mg ai/L**	**LC_{50} = 9.7 mg ai/L**	**NOAEC = 9.7 mg ai/L**
Citrus	FL Citrus	0.01	0.32	0.04	0.04
Fruits	MI Cherry	0.01	0.34	0.04	0.04
Cranberry[1]	NA	0.01	0.66	0.08	0.08

Bolded values meet or exceed the LOC for non-listed species of 0.5 for acute risk or 1.0 for chronic risk.
Shaded values meet or exceed the LOC for listed species of 0.05 for acute risk or 1.0 for chronic risk.
[1]Based on undiluted bog-water

6.1.2.2. Benthic Invertebrates

Because of the limited soil-binding characteristics of metalaxyl/mefenoxam, risk to water-column dwelling aquatic invertebrates is assumed to be protective of risk to sediment-dwelling (benthic) invertebrates.

6.1.3. Aquatic Plants

Metalaxyl

As shown in **Table 6.3,** no risk concerns were identified for aquatic plants. All RQ values for listed and non-listed vascular and non-vascular aquatic plants were below the LOC (=1.0). The

highest RQ is 0.03, based on exposure to listed vascular aquatic plants to undiluted cranberry bog water.

Mefenoxam

Existing Uses

No risk concerns were identified for non-listed and listed non-vascular aquatic plants or non-listed aquatic vascular plants.

RQ values could not be calculated for listed vascular aquatic plants because the endpoint is non-definitive (NOAEC< 3.0 mg ai/L; IC_{05} not available). A study conducted with *Lemna gibba* (MRID 43875307) reported a significant reduction in the number of fronds at all test concentrations. As a result, RQ values for listed vascular aquatic plants could not be calculated. Based on the effects observed at the lowest test concentration, this is likely an underestimation of the likelihood of the toxicity. As there are not enough data to preclude risk, risk to listed species of vascular aquatic plants is presumed.

Proposed Crop Group Conversion

No risks to non-listed and listed non-vascular aquatic plants or non-listed aquatic vascular plants are expected from the proposed crop group conversion. Due to the low application rate (<0.01 lbs ai/A), the risk conclusions for foliar and ground spray are protective of this proposed crop group conversion. Risk to listed species of vascular aquatic plants is presumed because RQ values could not be calculated and effects were seen at the lowest test concentration.

Table 6.3. Aquatic Plant Risk Quotients for Metalaxyl and Mefenoxam

Use Sites	Scenario	Vascular		Non-vascular	
		Non-listed	Listed	Non-listed	Listed
Metalaxyl					
		IC_{50} = 85 mg ai/L	**NOAEC = 57 mg ai/L**	**IC_{50} = 140 mg ai/L**	**NOAEC = 100 mg ai/L**
Citrus (Trees)	FL Citrus	0.01	0.02	0.01	0.01
Fruits	MI Cherry	0.01	0.02	0.01	0.01
Citrus (Nursery stock)	FL Citrus	0.01	0.02	0.01	0.01
Cranberry[1]	NA	0.02	0.03	0.01	0.02
Mefenoxam					
		IC_{50} = 77 mg ai/L	**NOAEC <3.0 mg ai/L**	**IC_{50} = 203 mg ai/L**	**NOAEC = 6.2 mg ai/L**
Citrus (Trees)	FL Citrus	0.01	NC	0.02	0.06
Fruits	MI Cherry	0.01	NC	0.02	0.07
Ornamentals	FL Citrus	0.01	NC	0.04	0.12
Cranberry[1]	NA	0.01	NC	0.04	0.13

NC=RQs were not calculated because endpoints were non-definitive
Bolded values meet or exceed the LOC of 1.0.
[1]Based on exposure to undiluted bog-water

6.1.4. Seed Treatment Risk Concerns for Aquatic Organisms

The highest seed treatment application rate for metalaxyl or mefenoxam is proso millet (0.0014 lbs ai/lb seed), equivalent to an application rate of 0.04 lbs ai/A. This rate is lower than any application rates for aerial or ground application rates for metalaxyl. As a result, the risk conclusions for aquatic species based on foliar and ground spray application are protective of seed treatment uses of metalaxyl and mefenoxam.

6.1.5. TEP Risk Concerns for Aquatic Organisms

Metalaxyl, when applied as part of the formulated product, Ridomil 2E-G (27.9% ai) may exhibit enhanced toxicity to freshwater fish, freshwater invertebrates, and estuarine/marine invertebrates relative to metalaxyl TGAI. The potential risk of metalaxyl TEP to aquatic organisms is estimated by calculating RQs using the peak spray drift only EECs for metalaxyl use on deciduous fruit trees and citrus and the acute toxicity values for Ridomil 2E-G. As shown in **Table 6.4,** the RQ calculated based on the highest aerial spray drift EECs exceeded the LOC for listed aquatic species (LOC=0.05) based on aerial application to deciduous fruit trees and citrus. As a result, aerial application of Ridomil 2E-G at the highest registered application rate for deciduous fruit trees and citrus may result in risk concerns to listed freshwater fish and estuarine/marine invertebrates. At this time, there are no active registrations of Ridomil 2E-G, so these risks may not be likely.

Table 6.4. Aquatic RQs Based on the Spray Drift Application of Metalaxyl as Part of the Formulated Product Ridomil 2E-G (27.9% ai)

Use	Scenario	Freshwater Fish RQ	Freshwater Invertebrate RQ	Estuarine/Marine Invertebrate RQ
Metalaxyl TEP				
		Rainbow Trout LC_{50} =5.13 mg ai/L	**Water Flea LC_{50} =12.5 mg ai/L**	**Eastern oyster EC_{50}= 4.44 mg ai/L**
Deciduous Fruits	MI Cherry EEC=0.464mg ai/L	0.09	0.04	0.10
	PA Apple EEC=0.477 mg ai/L	0.09	0.04	0.11
	GA Peach EEC=0.370 mg ai/L	0.07	0.03	0.08
Citrus	CA Citrus EEC= 0.355 mg ai/L	0.07	0.03	0.08
	FL Citrus EEC=0.281 mg ai/L	0.05	0.02	0.05

Shaded values indicate that RQ values meet or exceed the LOC (LOC=0.05) for listed aquatic species

6.2. Terrestrial Species

RQs for birds and mammals for all uses are shown in **Tables 6.5-6.7.** To avoid discussion about uses where no risks were identified, some RQs that are below their respective LOCs are not shown in the tables.

6.2.1. Birds, Reptiles and Terrestrial-Phase Amphibians

6.2.1.1.Acute and Chronic Risk

6.2.1.1.1. Metalaxyl

The results of analysis using the SIP program indicate that chronic and acute exposure of metalaxyl through drinking water alone is a potential exposure pathway of concern for birds, terrestrial-phase amphibians and reptiles.

On the other hand, STIR indicated that exposure to metalaxyl through droplet or vapor phase inhalation is not likely to be a potential pathway of concern for birds, terrestrial-phase amphibians and reptiles.

Acute Risk

Table 6.5 summarizes the acute, dose-based RQs for birds, reptiles and terrestrial-phase amphibians (for which birds serve as surrogates) for seed treatment uses. RQ values range from <0.01-0.48. Acute risk concerns to small (<20g) and medium (<100g), listed birds, based on dietary exposure, were identified for application rates equal to or greater than 0.0003 lbs ai/lb seed. No acute risk concerns to non-listed birds were identified based on seed treatment uses of metalaxyl.

Table 6.6 presents the acute, dose-based RQs for birds, terrestrial-phase amphibians and reptiles from foliar and ground spray application. Acute, dose-based RQs ranged from <0.01-4.6. The highest dose-based RQ of 4.6 was calculated based on drench application to citrus nursery stock. Dose-based LOC exceedances for listed species were identified for all body sizes of herbivorous and insectivorous birds for all uses, while exceedances for non-listed species were identified for all use rates except hops. No exceedances for granivorous birds were identified based on foliar or ground spray application rates.

Acute dietary-based RQs were not calculated for birds based on metalaxyl exposure because the endpoint is non-definitive (LC_{50}>10,000 mg/kg-diet; MRID 00234439). Instead, this non-definitive endpoint was compared directly to the dietary EECs calculated in T-REX. The highest dietary based EEC, calculated for short-grass feeding birds based on application rates for citrus nursery stock, is 2719. This is 4 times lower than the non-definitive acute dietary endpoint. This indicates that acute dietary risk to birds, reptiles, and terrestrial-phase amphibians is low for non-listed species. Although no effects were observed at the highest test concentration, there is some uncertainty related to the risk concerns for listed species, as the highest test concentrations are not sufficiently high to exclude potential risk to listed bird species (LOC=0.1). As a result, risks from dietary exposure to listed species cannot be precluded for all uses which result in EECs greater than 1000 mg/kg-diet. This includes all use rates higher than those for eggplant, pepper and tomato.

Chronic Risks

Table 6.7 outlines the chronic RQs for seed treatment uses. LOCs exceeded for corn (except sweet corn), sorghum and proso millet. RQs ranged from 0.02-1.48.

Table 6.8 presents RQ values for chronic dietary exposure of metalaxyl to birds based on aerial/ground application. RQ values ranged from 0.02-3.18, the highest RQ values were calculated based on the soil drench application rates for citrus nursery stock. Chronic dietary risk concerns for birds were identified for application rates for cranberry and all application rates higher than eggplant, pepper and tomato.

6.2.1.1.2. Mefenoxam

The results of analysis using the SIP program indicate that chronic and acute exposure of mefenoxam through drinking water alone is an potential exposure pathway of concern for birds, terrestrial-phase amphibians and reptiles.

On the other hand, STIR indicated that exposure to mefenoxam through droplet or vapor phase inhalation is not likely to be a potential pathway of concern for birds, terrestrial-phase amphibians and reptiles.

Existing Uses

Acute Risks

Table 6.5 summarizes acute RQ values for birds based on seed treatment uses of mefenoxam. The highest RQ value for seed treatment uses is 0.05 based on the application rates for soybeans and the highest RQ for the proposed crop group conversion for oilseed group 20 is 0.02. No acute risk concerns were identified for birds, reptiles and terrestrial-phase amphibians from existing or proposed seed treatment uses of mefenoxam.

Table 6.6 presents the acute, dose-based RQs for mefenoxam exposure to birds from aerial/ground spray application, which are a surrogate taxa to terrestrial-phase amphibians and reptiles. Acute, dose-based RQs ranged from <0.01-31. Acute dose-based were highest for small (≤20g) birds feeding primarily on short grass based on the application rates for ornamental plants. Acute dose-based risk concerns for non-listed bird were identified for all application rates higher than legume vegetables (1 application of 0.5 lbs ai/A). These risk concerns were primarily identified for herbivorous birds, but higher use rates also identified exceedances for insectivorous birds. LOC exceedances for listed species were identified for all of these uses above beans (succulent, snap) and caneberries (2x0.1 lbs ai/A). Risk concerns to listed insectivorous birds were identified for all use rates greater than those for hops.

Avian acute dietary-based RQs were not calculated for mefenoxam exposure because the endpoint is non-definitive (LC_{50}>4830 mg/kg-diet; MRID 43875303). A comparison of the highest test concentration in the dietary test of 4830 mg/kg-diet with the highest dietary EEC calculated in T-REX of 2719 indicates that there are no acute dietary risk concerns for non-listed species. The risks for non-listed species are more uncertain, as the highest EECs are greater than 10% of the non-definitive LC_{50}, which indicates that risk cannot be precluded to listed taxa for all uses of mefenoxam where EECs are greater than 483 mg ai/kg-diet (4830 mg/kg-diet*0.1=483 mg ai/kg diet).

Chronic Risks

Table 6.7 presents the chronic RQs for seed treatment uses of mefenoxam. The highest chronic avian RQ for seed treatment uses is 0.15, well below the LOC (=1) for chronic exposure, so there are no chronic risk concerns for birds, reptiles or terrestrial-phase amphibians for proposed or existing seed treatment uses of mefenoxam.

Table 6.8 presents RQ values for chronic dietary-based exposure of mefenoxam to birds. No chronic risk concerns for birds were identified for any application rates. The highest chronic RQ value is 0.90 based on application rates for blueberry, blackberry and bush berries.

Proposed Crop Group Conversion

No risks to birds are expected from the proposed crop group conversion.

Table 6.5. Avian Acute Dose-Based Risk Quotients (RQs) from Seed Treatment Uses

Use	Acute RQs					
	Small (20 g)		Medium (100 g)		Large (1000 g)	
	Method #1	Method #2	Method #1	Method #2	Method #1	Method #2
Metalaxyl						
Ornamental grasses	0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Flax	--	--	--	--	--	--
Cucumber, ect.,	--	--	--	--	--	--
Brassica (Cole) Leafy Vegetables	0.09	--	--	--	--	--
Barley, ect.	0.11	0.03	0.05	<0.01	0.02	<0.01
Corn (Sweet), ect	0.22	0.01	0.10	<0.01	0.03	<0.01
Corn (Unspecified), Sorghum	0.38	0.03	0.17	<0.01	0.05	<0.01
Proso Millet	0.48	0.03	0.21	<0.01	0.07	<0.01
Mefenoxam						
Barley, triticale, wheat	--	--	--	--	--	--
Oilseed Group 20*	0.03	<0.01	0.01	<0.01	<0.01	<0.01
Corn (sweet)	--	--	--	--	--	--
Cotton	--	--	--	--	--	--
Legumes	--	--	--	--	--	--
Soybeans	0.05	0.02	0.02	<0.01	0.01	<0.01

-- indicates that RQ is below the LOC and is not included for clarity
*Proposed crop group conversion
Method #1: Acute RQ = EEC(mg ai/kg-bw/day)/LD_{50}
Method #2: Acute RQ = EEC(mg ai./ft^2)/(LD_{50}*bw)
Shaded meet or exceed the avian acute listed species LOC (= 0.1)
Bolded meet or exceed the avian acute non-listed species LOC (= 0.5)

Table 6.6. Acute Dose-based (mg/kg bw) RQ values for Food Residues for Birds, Reptiles, and Terrestrial-Phase Amphibians from Labeled Uses of Metalaxyl and Mefenoxam (T-REX v. 1.5.2; June 6, 2013).

Primary Feeding Strategy →	**Herbivores and Omnivores**												**Insectivores**			**Granivores**		
Animal Size →	Small				Med				Large				Small	Med	Large	Small	Med	Large
Dietary Items →	**Short Grass**	**Tall Grass**	**Broad-leaf Plants**	**Fruits, pods, seeds, *etc.***	**Short Grass**	**Tall Grass**	**Broadleaf Plants**	**Fruits, pods, seeds, *etc.***	**Short Grass**	**Tall Grass**	**Broadleaf Plants**	**Fruits, pods, seeds, *etc.***	**Arthropods**			**Seeds, grains, *etc.***		
Use(s) ↓																		
Metalaxyl																		
Hops	0.45	0.21	0.25	0.03	0.20	0.09	0.11	0.01	0.06	0.03	0.04	<0.01	0.18	0.08	0.03	0.01	<0.01	<0.01
Fruiting Vegetables, Strawberry	**0.86**	0.40	0.49	0.05	0.39	0.18	0.22	0.02	0.12	0.06	0.07	0.01	0.34	0.15	0.05	0.01	0.01	<0.01
Cranberry	**1.63**	**0.75**	**0.92**	0.10	**0.73**	0.33	0.41	0.05	0.23	0.11	0.13	0.01	**0.64**	0.29	0.09	0.02	0.01	<0.01
Cole Crops, Cucurbit Vegetables, Leafy Vegetables, Lettuce	**0.78**	0.36	0.44	0.05	0.35	0.16	0.20	0.02	0.11	0.05	0.06	0.01	0.30	0.14	0.04	0.01	<0.01	<0.01
Eggplant, Pepper, Tomato	**1.33**	**0.61**	**0.75**	0.08	**0.60**	0.27	0.34	0.04	0.19	0.09	0.11	0.01	**0.52**	0.23	0.07	0.02	0.01	<0.01
Golf Course Turf, Ornamental Lawns And Turf, Ornamental Sod Farm (Turf), Recreation Area Lawns	**2.33**	**1.07**	**1.31**	0.15	**1.04**	0.48	0.59	0.07	0.33	0.15	0.19	0.02	**0.91**	0.41	0.13	0.03	0.01	<0.01
Papaya	**2.46**	**1.13**	**1.38**	0.15	**1.10**	0.50	**0.62**	0.07	0.35	0.16	0.20	0.02	**0.96**	0.43	0.14	0.03	0.02	<0.01
Citrus (Trees)	**1.86**	**0.85**	**1.04**	0.12	**0.83**	0.38	0.47	0.05	0.26	0.12	0.15	0.02	**0.73**	0.33	0.10	0.03	0.1	<0.01
Avocado, Deciduous Fruit Trees (Unspecified), Stone Fruits, Tree Nuts	**1.90**	**0.87**	**1.07**	0.12	**0.85**	0.39	0.48	0.05	0.27	0.12	0.15	0.02	**0.75**	0.33	0.11	0.03	0.01	<0.01
Citrus (Nursery stock)	**4.62**	**2.12**	**2.60**	0.29	**2.07**	**0.95**	**1.16**	0.13	**0.66**	0.30	0.37	0.04	**1.81**	**0.81**	0.26	0.06	0.03	0.01
Mefenoxam																		

Broccoli, Chinese Broccoli, Brussels Sprouts, Cabbage, Chinese Cabbage, Cauliflower	0.09	0.04	0.05	0.01	0.04	0.02	0.02	<0.01	0.01	0.01	0.01	<0.01	0.03	0.02	<0.01	<0.01	<0.01	<0.01
Bulb Vegetables	0.02	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Beans (succulent, snap), Caneberries	0.07	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Garlic	0.15	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Pepper, Radish	0.13	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Potato	0.07	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Leek, Shallot	0.11	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Melons, Pumpkin, Squash, Cucumber	0.16	0.07	0.09	0.01	0.07	0.03	0.04	<0.01	0.02	0.01	0.01	<0.01	0.06	0.03	0.01	<0.01	<0.01	<0.01
Hops	0.10	0.04	0.05	0.01	0.04	0.02	0.02	<0.01	0.01	0.01	0.01	<0.01	0.04	0.02	0.01	<0.01	<0.01	<0.01
Kiwi	0.29	0.13	0.16	0.02	0.13	0.06	0.07	0.01	0.04	0.02	0.02	<0.01	0.11	0.05	0.02	<0.01	<0.01	<0.01
Ginseng	0.30	0.14	0.17	0.02	0.13	0.06	0.07	0.01	0.04	0.02	0.02	<0.01	0.12	0.05	0.02	<0.01	<0.01	<0.01
Legume Vegetables	0.19	0.09	0.11	0.01	0.09	0.04	0.05	0.01	0.03	0.01	0.02	<0.01	0.08	0.03	0.01	<0.01	<0.01	<0.01
Fruiting Vegetables Strawberry	**0.51**	0.23	0.29	0.03	0.23	0.10	0.13	0.01	0.07	0.03	0.04	<0.01	0.20	0.09	0.03	0.01	<0.01	<0.01
Turf	**0.69**	0.32	0.39	0.04	0.31	0.14	0.17	0.02	0.10	0.04	0.06	0.01	0.27	0.12	0.04	0.01	<0.01	<0.01
Cranberry	**0.89**	0.41	0.50	0.06	0.40	0.18	0.23	0.03	0.13	0.06	0.07	0.01	0.35	0.16	0.05	0.01	0.01	<0.01
Carrots, Cucurbit Vegetables, Leafy Vegetables, Cole Crops, Spinach	0.39	0.18	0.22	0.02	0.17	0.08	0.10	0.01	0.05	0.03	0.03	<0.01	0.15	0.07	0.02	0.01	0.00	<0.01
Herbs, Tomato	**0.72**	0.33	0.41	0.05	0.32	0.15	0.18	0.02	0.10	0.05	0.06	0.01	0.28	0.13	0.04	0.01	0.00	<0.01
Subtropical fruit	**1.09**	0.50	**0.61**	0.07	0.49	0.22	0.27	0.03	0.15	0.07	0.09	0.01	0.43	0.19	0.06	0.02	0.01	<0.01
Tobacco	**0.58**	0.27	0.33	0.04	0.26	0.12	0.15	0.02	0.08	0.04	0.05	0.01	0.23	0.10	0.03	0.01	<0.01	<0.01
Blueberry, Bush Berries, Raspberry	**1.31**	**0.60**	**0.74**	0.08	**0.59**	0.27	0.33	0.04	0.19	0.09	0.10	0.01	**0.51**	0.23	0.07	0.02	0.01	<0.01
Orchards (Unspecified), Stone Fruits, Tree Nuts, Avocado	**1.08**	0.50	**0.61**	0.07	0.49	0.22	0.27	0.03	0.15	0.07	0.09	0.01	0.42	0.19	0.06	0.02	0.01	<0.01

Citrus, Deciduous Fruit Trees (Unspecified)	**0.93**	**0.43**	**0.52**	0.06	0.42	0.19	0.23	0.03	0.13	0.06	0.07	0.01	0.36	0.16	0.05	0.01	0.01	<0.01

-- indicates that RQ is below the LOC and is not included for clarity
Shaded meet or exceed the avian acute listed species LOC (= 0.1)
Bolded meet or exceed the avian acute non-listed species LOC (= 0.5)

Table 6.7. Avian Chronic Risk Quotients (RQs) for Seed Treatment Uses

Use	Chronic RQs		
	Small (20 g)	**Medium (100 g)**	**Large (1000 g)**
Metalaxyl			
Ornamental grasses	0.02	0.02	0.02
Flax	--	--	--
Cucumber, ect.,	--		--
Brassica (Cole) Leafy Vegetables	--	--	--
Barley, ect.	0.33	0.33	0.33
Corn (Sweet), ect	0.67	0.67	0.67
Corn (Unspecified), Sorghum	**1.17**	**1.17**	**1.17**
Proso Millet	**1.48**	**1.48**	**1.48**
Mefenoxam			
Barley, triticale, wheat	--	--	--
Oilseed Group 20	0.08	0.08	0.08
Corn (sweet)	--	--	--
Cotton	--	--	--
Legumes	--	--	--
Soybeans	0.15	0.15	0.15

-- indicates that RQ is below the LOC and is not included for clarity
Shaded, Bolded meet or exceed the avian chronic LOC for listed and non-listed species LOC (= 1.0)

Table 6.8. Chronic Dietary-based (mg/kg diet) RQ values for Food Residues for Birds, Reptiles, and Terrestrial-Phase Amphibians from Labeled Uses of Metalaxyl and Mefenoxam (T-REX v. 1.5.2; June 6, 2013).

Primary Feeding Strategy →	Herbivores, Omnivores, and Granivores				Insectivores
Dietary Items → / Use(s) ↓	Short Grass	Tall Grass	Broad-leaf Plants	Fruits, pods, seeds, *etc.*	Arthropods
Metalaxyl					
Hops	0.31	0.14	0.17	0.02	0.12
Fruiting Vegetables, Strawberry	0.59	0.27	0.33	0.04	0.23
Cranberry	**1.12**	0.51	0.63	0.07	0.44
Cole Crops, Cucurbit Vegetables, Leafy Vegetables, Lettuce	0.53	0.24	0.30	0.03	0.21
Eggplant, Pepper, Tomato	0.91	0.42	0.51	0.06	0.36
Golf Course Turf, Ornamental Lawns And Turf, Ornamental Sod Farm (Turf), Recreation Area Lawns	**1.61**	0.73	0.90	0.10	0.63
Papaya	**1.69**	0.77	0.95	0.11	0.66
Citrus (trees)	**1.28**	0.58	0.72	0.08	0.50
Avocado, Deciduous Fruit Trees (Unspecified), Stone Fruits, Tree Nuts	**1.31**	0.60	0.74	0.08	0.51
Citrus (Nursery stock)	**3.18**	**1.46**	**1.79**	0.20	**1.24**
Mefenoxam					
Broccoli, Chinese Broccoli, Brussels Sprouts, Cabbage, Chinese Cabbage, Cauliflower	0.06	0.03	0.03	<0.01	0.02
Bulb Vegetables	0.02	0.01	0.01	<0.01	0.01
Beans (succulent, snap), Caneberries	-	-	-	-	-
Garlic	-	-	-	-	-
Pepper, Radish	-	-	-	-	-
Potato	-	-	-	-	-
Leek, Shallot	-	-	-	-	-
Melons, Pumpkin, Squash, Cucumber	-	-	-	-	-
Hops	-	-	-	-	-
Kiwi	-	-	-	-	-
Ginseng	-	-	-	-	-
Legume Vegetables	-	-	-	-	-
Fruiting Vegetables, Strawberry	-	-	-	-	-
Turf	-	-	-	-	-
Cranberry	-	-	-	-	-
Carrots, Cucurbit Vegetables, Leafy Vegetables, Cole Crops, Spinach	-	-	-	-	-

Primary Feeding Strategy →	Herbivores, Omnivores, and Granivores				Insectivores
Dietary Items → / Use(s) ↓	Short Grass	Tall Grass	Broad-leaf Plants	Fruits, pods, seeds, *etc.*	Arthropods
Herbs, Tomato	-	-	-	-	-
Subtropical fruit	-	-	-	-	-
Tobacco	-	-	-	-	-
Blueberry, Bush Berries, Raspberry	0.90	0.41	0.51	0.06	0.35
Orchards (Unspecified), Stone Fruits, Tree Nuts, Avocado	0.75	0.34	0.42	0.05	0.29
Citrus, Deciduous Fruit Trees (Unspecified)	0.64	0.29	0.36	0.04	0.25

-- indicates that RQ is below the LOC and is not included for clarity
Shaded, Bolded values meet or exceed the chronic LOC for listed and non-listed species (= 1.0)

6.2.2. Mammals

6.2.2.1.Metalaxyl

The results of analysis using the SIP program indicate that chronic and acute exposure to metalaxyl through drinking water alone is a potential exposure pathway of concern for mammals.

On the other hand, STIR indicated that exposure to metalaxyl through droplet or vapor phase inhalation is not likely to be a potential pathway of concern for mammals.

Acute Risks
Table 6.9 outlines the acute RQs calculated for mammals based on seed treatment rates for metalaxyl. Acute LOC exceedances were calculated for listed species only, based on application rates to corn (except sweet corn), sorghum, and proso millet. RQs ranged from 0.01-0.19.

Table 6.10 outlines the dose-based mammalian RQ values from aerial/ground application rates of metalaxyl. LOC exceedances for non-listed species were identified for all assessed uses except fruiting vegetables, strawberry, and hops. Risk concerns to listed herbivorous and insectivorous mammals were identified for all uses.

Chronic Risks
Chronic risk concerns for seed treatment uses were identified for small and medium listed and non-listed mammals based on application rates for corn, sorghum, and proso millet. No chronic risk concerns were identified for lower seed treatment application rates. The highest RQ of 2.05 was calculated for proso millet.

Table 6.11 summarizes chronic, dose-based RQ values for exposure to metalaxyl based on aerial/ground application rates. Risk concerns to listed and non-listed herbivorous and insectivorous mammals were identified for all use rates. The highest chronic dose-based RQ

value of 19.85 was calculated based on the application rate for citrus nursery stock. Chronic, dietary-based RQs are listed in **Table 6.12.** Risk concerns were identified for uses on turf, papaya and citrus nursery stock . The highest RQ value was of 2.29 was calculated based on the application rates for citrus nursery stock. The magnitude of chronic dietary risk to mammals is uncertain, as no reproductive effects were observed in the 2-generation reproduction study with rats, and the NOAEC is presumed to be equal to the highest test concentration.

6.2.2.2.Mefenoxam

Existing Uses

The results of analysis using the SIP program indicate that chronic and acute exposure to mefenoxam through drinking water alone is a potential exposure pathway of concern for mammals.

On the other hand, STIR indicated that exposure to mefenoxam through droplet or vapor phase inhalation is not likely to be a potential pathway of concern for mammals.

Acute Risk

Table 6.9 summarizes the acute risk concerns from uses of mefenoxam as a seed treatment. No risk concerns are identified for existing or proposed uses of mefenoxam as a seed treatment.

Table 6.10 summarizes the dose-based RQs for mammals based on aerial and ground application rates. LOC exceedances for non-listed herbivorous mammal species from acute, dietary exposure to food items were identified for application rates equal to or greater than fruiting vegetables and strawberries (3x0.5 lbs ai/A). Risk concerns were identified for listed herbivorous and insectivorous mammals.

Chronic Risks

As shown in **Table 6.11,** no risk concerns were identified for mammals through chronic exposure to seeds treated with mefenoxam. The highest chronic RQ value for mefenoxam seed treatment uses is 0.20, based on the application rate for soybeans (0.00015 lbs ai/lb seed).

A summary of chronic, dose-based RQs is available in **Table 6.12.** Based on chronic, dose-based exposure to mefenoxam, risk concerns are identified for application rates greater than usage rates on hops (1x0.25 lbs ai/A). The highest RQ value for chronic, dose-based exposure is 5.64, resulting from the application rates for blueberries, bush berries and raspberries. Chronic dietary-based exposure RQs are listed in **Table 6.13.** No chronic dietary-based risk concerns are identified for any uses of mefenoxam, and the highest RQ calculated is 0.28 based on the application rates for blueberries, bush berries and raspberries. The magnitude of chronic risk to mammals based on dietary exposure to mefenoxam remains uncertain, as no reproductive effects were observed in the 2-generation reproduction study with rats up to the highest test concentration, and the NOAEC is assumed to be equal to the highest test concentration.

Proposed Crop Group Conversion

No risks to mammals are expected from the proposed crop group conversion.

Table 6.9. Mammalian Acute Dose-Based Risk Quotients (RQs) for Seed Treatment Uses of Metalaxyl and Mefenoxam

Use	Acute RQs					
	Small (20 g)		Medium (100 g)		Large (1000 g)	
	Method #1	Method #2	Method #1	Method #2	Method #1	Method #2
Metalaxyl						
Ornamental grasses	0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Flax	--	--	--	--	--	--
Cucumber, ect.,	--	--	--	--	--	--
Brassica (Cole) Leafy Vegetables	--	--	--	--	--	--
Barley, ect.	0.04	0.02	0.04	0.01	0.02	<0.01
Corn (Sweet), ect	0.09	0.01	0.07	<0.01	0.04	<0.01
Corn (Unspecified), Sorghum	0.15	0.01	0.13	0.01	0.07	<0.01
Proso Millet	0.19	0.02	0.16	0.01	0.09	<0.01
Mefenoxam						
Barley, triticale, wheat	--	--	--	--	--	--
Oilseed Group 20	0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Corn (sweet)	--	--	--	--	--	--
Cotton	--	--	--	--	--	--
Legumes	--	--	--	--	--	--
Soybeans	0.01	0.01	0.01	<0.01	<0.01	<0.01

-- indicates that RQ is below the LOC and is not included for clarity

Method #1: Acute RQ = EEC(mg ai/kg-bw/day)/LD_{50}

Method #2: Acute RQ = EEC(mg ai/ft^2)/(LD_{50}*bw)

Shaded meet or exceed the avian acute listed species LOC (= 0.1)

Bolded meet or exceed the avian acute non-listed species LOC (= 0.5)

Table 6.10. Acute Dose-based (mg/kg bw) RQ values for Food Residues for Mammals from Labeled Uses of Metalaxyl and Mefenoxam (T-REX v. 1.5.2; June 6, 2013).

Primary Feeding Strategy →	Herbivores and Omnivores												Insectivores			Granivores		
Animal Size →	Small				Med				Large				Small	Med	Large	Small	Med	Large
Dietary Items → / Use(s) ↓	Short Grass	Tall Grass	Broad-leaf Plants	Fruits, pods, seeds, *etc.*	Short Grass	Tall Grass	Broadleaf Plants	Fruits, pods, seeds, *etc.*	Short Grass	Tall Grass	Broadleaf Plants	Fruits, pods, seeds, *etc.*	Arthropods			Seeds, grains, *etc.*		
Metalaxyl																		
Hops	0.18	0.08	0.10	0.01	0.16	0.07	0.09	0.01	0.08	0.04	0.05	0.01	0.07	0.06	0.03	<0.01	<0.01	<0.01
Fruiting Vegetables, Strawberry	0.35	0.16	0.19	0.02	0.30	0.14	0.17	0.02	0.16	0.07	0.09	0.01	0.14	0.12	0.06	<0.01	<0.01	<0.01
Cranberry	**0.65**	0.30	0.37	0.04	**0.56**	0.26	0.31	0.03	0.30	0.14	0.17	0.02	0.26	0.22	0.12	0.01	0.01	<0.01
Cole Crops, Cucurbit Vegetables, Leafy Vegetables, Lettuce	0.31	0.14	0.18	0.02	0.27	0.12	0.15	0.02	0.14	0.07	0.08	0.01	0.12	0.10	0.06	<0.01	<0.01	<0.01
Eggplant, Pepper, Tomato	**0.53**	0.24	0.30	0.03	0.46	0.21	0.26	0.03	0.24	0.11	0.14	0.02	0.21	0.18	0.10	0.01	0.01	<0.01
Golf Course Turf, Ornamental Lawns And Turf, Ornamental Sod Farm (Turf), Recreation Area Lawns	**0.93**	0.43	**0.53**	0.06	**0.80**	0.37	0.45	0.05	0.43	0.20	0.24	0.03	0.37	0.31	0.17	0.01	0.01	0.01
Papaya	**0.98**	0.45	**0.55**	0.06	**0.84**	0.39	0.47	0.05	0.45	0.21	0.25	0.03	0.39	0.33	0.18	0.01	0.01	0.01
Citrus (trees)	**0.74**	0.34	**0.42**	0.05	**0.64**	0.29	0.36	0.04	0.34	0.16	0.19	0.02	0.29	0.25	0.13	0.01	0.01	<0.01
Avocado, Deciduous Fruit Trees (Unspecified), Stone Fruits, Tree Nuts	**0.76**	0.35	**0.43**	0.05	**0.65**	0.30	0.37	0.04	0.35	0.16	0.20	0.02	0.30	0.26	0.14	0.01	0.01	<0.01
Citrus (nurserystock)	**1.85**	**0.85**	**1.04**	0.12	**1.58**	**0.73**	**0.89**	0.10	**0.85**	0.39	0.48	0.05	**0.73**	**0.62**	0.33	0.03	0.02	0.01
Mefenoxam																		
Broccoli, Chinese Broccoli, Brussels	0.02	0.01	0.01	<0.01	0.02	0.01	0.01	0.00	0.01	<0.01	<0.01	<0.01	0.01	0.01	<0.01	<0.01	<0.01	<0.01

Primary Feeding Strategy →	Herbivores and Omnivores												Insectivores			Granivores		
Animal Size →	Small				Med				Large				Small	Med	Large	Small	Med	Large
Dietary Items → / Use(s) ↓	Short Grass	Tall Grass	Broad-leaf Plants	Fruits, pods, seeds, *etc.*	Short Grass	Tall Grass	Broadleaf Plants	Fruits, pods, seeds, *etc.*	Short Grass	Tall Grass	Broadleaf Plants	Fruits, pods, seeds, *etc.*	Arthropods			Seeds, grains, *etc.*		
Sprouts, Cabbage, Chinese Cabbage, Cauliflower																		
Bulb Vegetables	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Beans (succulent, snap), Caneberries	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Garlic	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Pepper, Radish	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Potato	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Leek, Shallot	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Melons, Pumpkin, Squash, Cucumber	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Hops	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Kiwi	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Ginseng	0.06	0.03	0.04	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Legume Vegetables	0.04	0.02	0.02	<0.01	0.04	0.02	0.02	<0.01	0.02	0.01	0.01	<0.01	0.02	0.01	0.01	--	--	--
Fruiting Vegetables, Strawberry	0.11	0.05	0.06	0.01	0.09	0.04	0.05	0.01	0.05	0.02	0.03	<0.01	0.04	0.04	0.02	--	--	--
Turf	0.15	0.07	0.08	0.01	0.13	0.06	0.07	0.01	0.07	0.03	0.04	<0.01	0.06	0.05	0.03	--	--	--
Cranberry	0.19	0.09	0.11	0.01	0.16	0.07	0.09	0.01	0.09	0.04	0.05	0.01	0.07	0.06	0.03	--	--	--
Carrots, Cucurbit Vegetables, Leafy Vegetables, Cole Crops, Spinach	0.08	0.04	0.05	0.01	0.07	0.03	0.04	<0.01	0.04	0.02	0.02	0.00	0.65	0.56	0.30	<0.01	<0.01	<0.01
Herbs, Tomato	0.15	0.07	0.09	0.01	0.13	0.06	0.07	0.01	0.07	0.03	0.04	0.00	0.06	0.05	0.03	<0.01	<0.01	<0.01
Subtropical fruit	0.23	0.11	0.13	0.01	0.20	0.09	0.11	0.01	0.11	0.05	0.06	0.01	0.09	0.08	0.04	<0.01	<0.01	<0.01

Primary Feeding Strategy →	Herbivores and Omnivores												Insectivores			Granivores		
Animal Size →	Small				Med				Large				Small	Med	Large	Small	Med	Large
Dietary Items → / Use(s) ↓	Short Grass	Tall Grass	Broad-leaf Plants	Fruits, pods, seeds, *etc.*	Short Grass	Tall Grass	Broadleaf Plants	Fruits, pods, seeds, *etc.*	Short Grass	Tall Grass	Broadleaf Plants	Fruits, pods, seeds, *etc.*	Arthropods			Seeds, grains, *etc*.		
Tobacco	0.12	0.06	0.07	0.01	0.11	0.05	0.06	0.01	0.06	0.03	0.03	<0.01	0.05	0.04	0.02	<0.01	<0.01	<0.01
Blueberry, Bush Berries, Raspberry	0.28	0.13	0.16	0.02	0.24	0.11	0.13	0.01	0.13	0.06	0.07	0.01	0.11	0.09	0.05	<0.01	<0.01	<0.01
Orchards (Unspecified), Stone Fruits, Tree Nuts, Avocado	0.23	0.11	0.13	0.01	0.20	0.09	0.11	0.01	0.11	0.05	0.06	0.01	0.09	0.08	0.04	<0.01	<0.01	<0.01
Citrus, Deciduous Fruit Trees (Unspecified)	0.20	0.09	0.11	0.01	0.17	0.08	0.09	0.01	0.09	0.04	0.05	0.01	0.08	0.07	0.04	<0.01	<0.01	<0.01

-- indicates that RQ is below the LOC and is not included for clarity
Shaded meets or exceeds the mammalian acute listed species LOC (= 0.1)
Bolded meets or exceeds the mammalian acute non-listed species LOC (= 0.5)

Table 6.11. Mammalian Chronic Risk Quotients (RQs) for Seed Treatment Rates of Metalaxyl and Mefenoxam

Use	Chronic RQs		
	Small (20 g)	Medium (100 g)	Large (1000 g)
Metalaxyl			
Ornamental grasses	0.03	0.02	0.01
Flax	--	--	--
Cucumber, ect.,	--	--	--
Brassica (Cole) Leafy Vegetables	--	--	--
Barley, ect.	0.46	0.39	0.21
Corn (Sweet), ect	0.92	0.79	0.42
Corn (Unspecified), Sorghum	**1.63**	**1.39**	0.75
Proso Millet	**2.05**	**1.76**	0.94
Mefenoxam			
Barley, triticale, wheat	--	--	--

Use	Chronic RQs		
	Small (20 g)	Medium (100 g)	Large (1000 g)
Oilseed Group 20	0.11	0.09	0.05
Corn (sweet)	--	--	--
Cotton	--	--	--
Legumes	--	--	--
Soybeans	0.20	0.17	0.09

-- indicates that RQ is below the LOC and is not included for clarity
Shaded, Bolded values meets or exceeds the mammalian chronic LOC for listed and non-listed species (= 1.0)

Table 6.12. Upper Bound Kenaga Chronic Dose-based (mg/kg bw) RQ values for Food Residues for Mammals from Labeled Uses of Metalaxyl and Mefenoxam (T-REX v. 1.5.2; June 6, 2013).

Primary Feeding Strategy →	Herbivores and Omnivores												Insectivores			Granivores		
Animal Size →	Small				Med				Large				Small	Med	Large	Small	Med	Large
Dietary Items → / Use(s) ↓	Short Grass	Tall Grass	Broad-leaf Plants	Fruits, pods, seeds, *etc.*	Short Grass	Tall Grass	Broadleaf Plants	Fruits, pods, seeds, *etc.*	Short Grass	Tall Grass	Broadleaf Plants	Fruits, pods, seeds, *etc.*	Arthropods			Seeds, grains, *etc.*		
Metalaxyl																		
Hops	**1.94**	0.89	**1.09**	0.12	**1.66**	0.76	0.93	0.10	0.89	0.41	0.50	0.06	0.76	0.65	0.35	0.03	0.02	0.01
Fruiting Vegetables, Strawberry	**3.70**	**1.70**	**2.08**	0.23	**3.16**	**1.45**	**1.78**	0.20	**1.70**	0.78	0.95	0.11	**1.45**	**1.24**	0.66	0.05	0.04	0.02
Cranberry	**6.99**	**3.21**	**3.93**	0.44	**5.97**	**2.74**	**3.36**	0.37	**3.20**	**1.47**	**1.80**	0.20	**2.74**	**2.34**	**1.25**	0.10	0.08	0.04
Cole Crops, Cucurbit Vegetables, Leafy Vegetables, Lettuce	**3.33**	**1.53**	**1.87**	0.21	**2.85**	**1.30**	**1.60**	0.18	**1.53**	0.70	0.86	0.10	**1.30**	**1.11**	0.60	0.05	0.04	0.02
Eggplant, Pepper, Tomato	**5.71**	**2.62**	**3.21**	0.36	**4.88**	**2.24**	**2.74**	0.30	**2.61**	**1.20**	**1.47**	0.16	**2.24**	**1.91**	**1.02**	0.08	0.07	0.04
Golf Course Turf, Ornamental Lawns And Turf, Ornamental Sod Farm (Turf), Recreation Area Lawns	**10**	**4.58**	**5.63**	0.63	**8.54**	**3.92**	**4.81**	0.53	**4.58**	**2.10**	**2.58**	0.29	**3.92**	**3.35**	**1.79**	0.14	0.12	0.06

Primary Feeding Strategy →	Herbivores and Omnivores												Insectivores			Granivores		
Animal Size →	Small				Med				Large				Small	Med	Large	Small	Med	Large
Dietary Items → / Use(s) ↓	Short Grass	Tall Grass	Broad-leaf Plants	Fruits, pods, seeds, *etc.*	Short Grass	Tall Grass	Broadleaf Plants	Fruits, pods, seeds, *etc.*	Short Grass	Tall Grass	Broadleaf Plants	Fruits, pods, seeds, *etc.*	Arthropods			Seeds, grains, *etc.*		
Papaya	**10.54**	**4.83**	**5.93**	0.66	**9.00**	**4.13**	**5.07**	0.56	**4.83**	**2.21**	**2.72**	0.30	**4.13**	**3.53**	**1.89**	0.15	0.13	0.07
Citrus (Trees)	**7.97**	**3.65**	**4.48**	0.50	**6.81**	**3.12**	**3.83**	0.43	**3.65**	**1.67**	**2.05**	0.23	**3.12**	**2.67**	**1.43**	0.11	0.09	0.05
Avocado, Deciduous Fruit Trees (Unspecified), Stone Fruits, Tree Nuts	**8.17**	**3.75**	**4.60**	0.51	**6.98**	**3.20**	**3.93**	0.44	**3.74**	**1.72**	**2.10**	0.23	**3.20**	**2.73**	**1.47**	0.11	0.10	0.05
Citrus (Nurserystock)	**19.85**	**9.10**	**11.2**	**1.24**	**17.0**	**7.77**	**9.54**	**1.06**	**9.09**	**4.17**	**5.11**	0.57	**7.77**	**6.64**	**3.56**	0.28	0.24	0.13
Mefenoxam																		
Broccoli, Chinese Broccoli, Brussels Sprouts, Cabbage, Chinese Cabbage, Cauliflower	0.38	0.17	0.21	0.02	0.32	0.15	0.18	0.02	0.17	0.08	0.10	0.01	0.15	0.13	0.07	0.01	<0.01	<0.01
Bulb Vegetables	0.10	0.05	0.06	0.01	0.09	0.04	0.05	0.01	0.05	0.02	0.03	<0.01	0.04	0.03	0.02	<0.01	<0.01	<0.01
Beans (succulent, snap), Caneberries	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Garlic	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Pepper, Radish	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Potato	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Leek, Shallot	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Melons, Pumpkin, Squash, Cucumber	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Hops	0.42	0.19	0.23	0.03	0.36	0.16	--	--	--	--	--	--	--	--	--	--	--	--
Kiwi	**1.23**	--	--	--	**1.05**	--	--	--	--	--	--	--	--	--	--	--	--	--
Ginseng	**1.28**	0.59	0.72	--	**1.09**	--	0.62	--	0.59	--	--	--	--	--	--	--	--	--

Primary Feeding Strategy →	Herbivores and Omnivores												Insectivores			Granivores		
Animal Size →	Small				Med				Large				Small	Med	Large	Small	Med	Large
Dietary Items → / Use(s) ↓	Short Grass	Tall Grass	Broad-leaf Plants	Fruits, pods, seeds, *etc.*	Short Grass	Tall Grass	Broadleaf Plants	Fruits, pods, seeds, *etc.*	Short Grass	Tall Grass	Broadleaf Plants	Fruits, pods, seeds, *etc.*	Arthropods			Seeds, grains, *etc.*		
Legume Vegetables	0.83	0.38	0.47	0.05	0.71	0.33	0.40	0.04	0.38	0.17	0.21	0.02	0.33	0.28	0.15	0.01	0.01	0.01
Fruiting Vegetables, Strawberry	**2.19**	**1.00**	**1.23**	0.14	**1.87**	0.86	1.05	0.12	**1.00**	0.46	0.56	0.06	0.86	0.73	0.39	0.03	0.03	0.01
Turf	**2.98**	**1.36**	**1.67**	0.19	**2.54**	**1.17**	**1.43**	0.16	**1.36**	0.62	0.77	0.09	**1.17**	1.00	0.53	0.04	0.04	0.02
Cranberry	**3.85**	**1.77**	**2.17**	0.24	**3.29**	**1.51**	**1.85**	0.21	**1.76**	0.81	0.99	0.11	**1.51**	**1.29**	0.69	0.05	0.05	0.02
Carrots, Cucurbit Vegetables, Leafy Vegetables, Cole Crops, Spinach	**1.67**	0.76	0.94	0.10	**1.42**	0.65	0.80	0.09	0.76	0.35	0.43	0.05	0.65	0.56	0.30	0.02	0.02	0.01
Herbs, Tomato	**3.12**	**1.43**	**1.75**	0.19	**2.66**	**1.22**	**1.50**	0.17	**1.43**	0.65	0.80	0.09	**1.22**	**1.04**	0.56	0.04	0.04	0.02
Subtropical fruit	**4.67**	**2.14**	**2.63**	0.29	**3.99**	**1.83**	**2.25**	0.25	**2.14**	0.98	**1.20**	0.13	**1.83**	**1.56**	0.84	0.06	0.06	0.03
Tobacco	**2.50**	**1.15**	**1.41**	0.16	**2.13**	0.98	**1.20**	0.13	0.06	0.03	0.03	0.00	0.98	0.84	0.45	0.03	0.03	0.02
Blueberry, Bush Berries, Raspberry	**5.64**	**2.58**	**3.17**	0.35	**4.82**	**2.21**	**2.71**	0.30	**2.58**	**1.18**	**1.45**	0.16	**2.21**	**1.89**	**1.01**	0.08	0.07	0.04
Orchards (Unspecified), Stone Fruits, Tree Nuts, Avocado	**4.66**	**2.13**	**2.62**	0.29	**3.98**	**1.82**	**2.24**	0.25	**2.13**	**0.98**	**1.20**	0.13	**1.82**	**1.56**	0.84	0.06	0.06	0.03
Citrus, Deciduous Fruit Trees (Unspecified)	**3.99**	**1.83**	**2.24**	0.25	**3.41**	**1.56**	**1.92**	0.21	**1.83**	0.84	**1.03**	0.11	**1.56**	**1.33**	**0.71**	0.06	0.05	0.03

-- indicates that RQ is below the LOC and is not included for clarity

Shaded, Bolded values meet or exceed the chronic LOC for listed and non-listed species (= 1)

Table 6.13. Chronic Dietary-based (mg/kg diet) RQ values for Food Residues for Mammals from Labeled Uses of Metalaxyl and Mefenoxam (T-REX v. 1.5.2; June 6, 2013)

Primary Feeding Strategy →	Herbivores, Omnivores, and Granivores				Insectivores
Dietary Items → / Use(s) ↓	Short Grass	Tall Grass	Broad-leaf Plants	Fruits, pods, seeds, *etc.*	Arthropods
Metalaxyl					
Hops	--	--	--	--	--
Fruiting Vegetables, Strawberry	--	--	--	--	--
Cranberry	--	--	--	--	--
Cole Crops, Cucurbit Vegetables, Leafy Vegetables, Lettuce	0.38	0.18	0.22	0.02	0.15
Eggplant, Pepper, Tomato	0.66	0.30	0.37	0.04	0.26
Golf Course Turf, Ornamental Lawns And Turf, Ornamental Sod Farm (Turf), Recreation Area Lawns	**1.15**	0.53	0.65	0.07	0.45
Papaya	**1.22**	0.56	0.68	0.08	0.48
Citrus (trees)	0.92	0.42	0.52	0.06	0.36
Avocado, Deciduous Fruit Trees (Unspecified), Stone Fruits, Tree Nuts	0.94	0.43	0.53	0.06	0.37
Citrus (Nurserystock)	**2.29**	**1.05**	**1.29**	0.14	0.90
Mefenoxam					
Broccoli, Chinese Broccoli, Brussels Sprouts, Cabbage, Chinese Cabbage, Cauliflower	0.04	0.02	0.02	<0.01	0.02
Bulb Vegetables	0.01	0.01	0.01	<0.01	<0.01
Beans (succulent, snap), Caneberries	--	--	--	--	--
Garlic	--	--	--	--	--
Pepper, Radish	--	--	--	--	--
Potato	--	--	--	--	--
Leek, Shallot	--	--	--	--	--
Melons, Pumpkin, Squash, Cucumber	--	--	--	--	--
Hops	--	--	--	--	--
Kiwi	--	--	--	--	--
Ginseng	--	--	--	--	--
Legume Vegetables	--	--	--	--	--
Fruiting Vegetables, Strawberry	--	--	--	--	--
Turf	--	--	--	--	--
Cranberry	--	--	--	--	--
Carrots, Cucurbit Vegetables, Leafy Vegetables, Cole Crops, Spinach	--	--	--	--	--
Herbs, Tomato	--	--	--	--	--

Primary Feeding Strategy →	Herbivores, Omnivores, and Granivores				Insectivores
Dietary Items → / Use(s) ↓	Short Grass	Tall Grass	Broad-leaf Plants	Fruits, pods, seeds, *etc.*	Arthropods
Subtropical fruit	--	--	--	--	--
Tobacco	--	--	--	--	--
Blueberry, Bush Berries, Raspberry	0.65	0.30	0.37	0.04	0.25
Orchards (Unspecified), Stone Fruits, Tree Nuts, Avocado	0.54	0.25	0.30	0.03	0.21
Citrus, Deciduous Fruit Trees (Unspecified)	0.46	0.21	0.26	0.03	0.18

-- indicates that RQ is below the LOC and is not included for clarity
Shaded, Bolded values meet or exceed the chronic LOC for listed and non-listed species (= 1.0)

6.2.3. Terrestrial Invertebrates

The honeybee acute contact toxicity with metalaxyl did not report the percent active ingredient of the test material, so the endpoint is non-definitive and RQs could not be calculated. The study report indicates that it is conducted with "technical-grade material." As the non-definitive endpoint (>100 µg ai/bee) is more than 7 times greater than the highest adult contact EEC for metalaxyl based on avocado, deciduous fruit trees (unspecified), stone fruits, tree nuts (11.07 µg ai/bee), it is likely to be protective of risks to adult honeybees from acute exposure on a contact basis. The contact toxicity endpoint for mefenoxam (LD_{50}>25 µg ai/ bee) is likely to be protective of the highest contact EEC for honeybees based on the highest application rate for mefenoxam on citrus and deciduous trees (5.4 µg ai/ bee).

No toxicity data are available for calculation of chronic RQs for adult bees or for acute or chronic RQs for bee larvae. Therefore, there is uncertainty regarding the potential acute and chronic effects of metalaxyl and mefenoxam on honey bee larvae as well as potential for chronic effects on adult bees. As both metalaxyl and mefenoxam are systemic compounds, translocated residues as well as residues from sub-lethal concentrations of spray drift on plants may be present in pollen and/or nectar and represent a route of exposure for bees through both contact and ingestion. Therefore, additional data on pollinators is needed to fully characterize the risk associated with metalaxyl and mefenoxam use to all developmental stages of honey bees, as sensitivity may vary according to life-stage and length of exposure (adult vs. larval and acute vs. chronic, respectively). These data are required under the Guidance for Assessing Pesticide Risks to Bees (USEPA *et al.*, 2014).

6.2.4. Terrestrial Plants

6.2.4.1.Metalaxyl

Table 6.14 summarizes risks to non-target monocotyledonous (monocot) plants. Risk concerns to listed and non-listed monocot plants were identified for application rates higher than turf. All of these risk concerns were identified for non-target plants in semi-aquatic areas based on a combination of runoff and spray drift. RQs for non-listed monocots ranged from <0.1 to 3.25, and RQs for listed monocots ranged from <0.1-5.20, where the highest RQs were calculated based on soil drench application rates to citrus nursery stock.

Table 6.15 summarizes risks to non-target dicotyledonous (dicot) plants. RQ values for listed plants exceed the LOC (=1) for all application rates except hops, while risks to non-listed dicots were identified for all uses higher than papaya. These risk concerns were identified for runoff and spray drift exposure to non-target dicot plants growing in semi-aquatic areas. In addition, additional risk concerns for listed dicots were identified for citrus nursery stock in dry areas. RQ values for non-listed dicots ranged from <0.1-2.64, and RQs for listed species ranged from <0.1-10.2.

RQ values for non-listed monocot or dicot plants based on spray drift application were not calculated because the vegetative vigor endpoints are non-definitive (EC_{25}>4.1 lbs ai/A; MRID 49024015). Instead, risk no non-listed species from spray drift application is assumed to be low, as the maximum application rate is equal to the non-definitive endpoint from the vegetative vigor study.

The highest seed treatment application rate for proso millet is equivalent to an application rate of 0.04 lbs ai/A, which is below any application rate where risks to monocots or dicots were identified.

6.2.4.2.Mefenoxam

Existing Uses

Risk concerns were identified for listed monocots growing in semi-aquatic areas based on the application rates for mefenoxam on orchards (unspecified), stone fruits, tree nuts, avocado, citrus, deciduous fruit trees (unspecified), and ornamental plants, as well as aerial application rates for citrus, blueberries and bushberries. No risk concerns were identified for non-listed monocot. No spray drift LOC exceedances were identified for listed or non-listed monocot species.

RQs were not calculated for non-listed dicots in dry or semi-aquatic areas, because the seedling emergence endpoint (dicot EC_{25}>3.06; MRID 49049807) is non-definitive. To estimate risks to non-listed dicots in dry and semi-aquatic environments, the highest EECs (1.1 lbs ai/A for semi-aquatic areas and 0.2 lbs ai/A for dry areas, based on aerial application at the 2.0 lbs ai/A application rate for citrus) were compared directly to the non-definitive seedling emergence endpoint (>3.06 lbs ai/A). As both of the EECs are below the non-definitive endpoints for dicots, there is a low likelihood of risk to non-listed plants in dry and semi-aquatic areas. No risks were identified for monocots based on spray drift, as the highest application rate for mefenoxam is 2.0

lbs ai/A is below the highest test concentration in the vegetative vigor study with monocots (EC_{25}>2.73 lb ai/A).

The highest seed treatment application rate for mefenoxam use on soybeans (4.23 fl oz/CWT) (4.8% ai) is equivalent to an application rate (0.02 lbs ai/A) below all assessed foliar application rates so no risks are expected to terrestrial plants.

Proposed Crop Group Conversion

No risks to non-listed and listed terrestrial plants are expected from the proposed crop group conversion. The seed treatment application rate for mefenoxam use on canola (0.32 fl oz/CWT) (4.8% ai) is equivalent to an application rate (>0.01 lbs ai/A) below all assessed foliar application rates.

Table 6.14. Terrestrial Plant- Monocot Risk Quotients

Crop	Single Max. Application Rate (lbs ai/A)	Application Type	Runoff and Spray Drift (Dry Areas)		Runoff and Spray Drift (Semi-Aquatic Areas)		Spray Drift Only	
			Non-Listed	Listed	Non-Listed	Listed	Non-Listed	Listed
Metalaxyl								
Hops	0.5	Ground	--	--	--	--	NC	NC
Fruiting Vegetables, Strawberry	1	Aerial	--	--	--	--	NC	NC
		Ground	--	--	--	--	NC	NC
Cranberry	1.8	Ground	--	0.11	0.57	0.92	NC	NC
Cole Crops, Cucurbit Vegetables, Leafy Vegetables, Lettuce, Root And Tuber Vegetables, Eggplant, Pepper, Tomato, Spinach	2	Ground	<0.1	0.12	0.64	**1.02**	NC	NC
Golf Course Turf, Ornamental Lawns And Turf, Ornamental Sod Farm (Turf), Recreation Area Lawns	2.7	Ground	0.10	0.16	0.86	**1.38**	NC	NC
Papaya	3.6	Ground	0.14	0.22	**1.15**	**1.84**	NC	NC
Citrus (Trees)	4.0	Aerial	0.25	0.40	**1.38**	**2.20**	NC	NC
		Ground	0.15	0.24	**1.28**	**2.04**	NC	NC
Avocado, Deciduous Fruit Trees (Unspecified), Stone Fruits, Tree Nuts	4.1	Aerial	0.26	0.41	**1.41**	**2.26**	NC	NC
		Ground	0.15	0.25	**1.31**	**2.09**	NC	NC
Citrus (Nurserystock)	10.2	Ground	0.38	0.61	**3.25**	**5.20**	NC	NC
Mefenoxam								
Broccoli, Chinese Broccoli, Brussels Sprouts, Cabbage, Chinese Cabbage, Cauliflower	0.062494	Aerial	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
		Ground	--	--	--	--	--	--
Bulb Vegetables	0.065528	Ground	--	--	--	--	--	--
Garlic	0.1	Aerial	--	--	--	--	--	--
Beans (succulent, snap), Caneberries, Garlic, Pepper, Radish, Potato		Ground	--	--	--	--	--	--

Crop	Single Max. Application Rate (lbs ai/A)	Application Type	Runoff and Spray Drift (Dry Areas)		Runoff and Spray Drift (Semi-Aquatic Areas)		Spray Drift Only	
			Non-Listed	Listed	Non-Listed	Listed	Non-Listed	Listed
Leek, Shallot	0.104	Aerial	--	--	--	--	--	--
		Ground	--	--	--	--	--	--
Melons, Pumpkin, Squash, Cucumber	0.135	Aerial	--	--	--	--	--	--
		Ground	--	--	--	--	--	--
Hops	0.25	Ground	--	--	--	--	--	--
Kiwi	0.35	Ground	--	--	--	--	--	--
Ginseng	0.38	Ground	--	--	--	--	--	--
Legume Vegetables, Fruiting Vegetables	0.5	Aerial	--	--	--	--	--	--
Legume Vegetables, Fruiting Vegetables, Strawberry		Ground	--	--	--	--	--	--
Turf	0.68	Ground	--	--	--	--	--	--
Cranberry	0.88	Ground	--	--	--	--	--	--
Carrots, Cucurbit Vegetables, Leafy Vegetables, Cole Crops, Tomato	1	Aerial	--	--	--	--	--	--
Carrots, Cucurbit Vegetables, Leafy Vegetables, Cole Crops, Spinach, Herbs, Tomato		Ground	--	--	--	--	--	--
Subtropical fruit, Tobacco	1.5	Ground	--	--	0.48	0.77	--	--
Blueberry, Bush Berries,	1.81	Aerial	0.11	0.18	0.62	**1.00**	--	--
Blueberry, Bush Berries, Raspberry		Ground	--	0.11	0.58	0.92	--	--
Orchards (Unspecified), Stone Fruits, Tree Nuts, Avocado, Citrus, Deciduous Fruit Trees (Unspecified)	2	Ground	<0.1	0.12	0.64	**1.02**	--	--
Citrus	2	Aerial	0.13	0.20	0.69	**1.10**	<0.1	<0.1

-- indicates that RQ is below the LOC and is not included for clarity
Bolded RQ values exceed the LOC of 1.0.

Table 6.15 Terrestrial Plant- Dicot Risk Quotients

Crop	Single Max. Application Rate (lbs ai/A)	Application Type	Runoff and Spray Drift (Dry Areas)		Runoff and Spray Drift (Semi-Aquatic Areas)		Spray Drift Only	
			Non-Listed	Listed	Non-Listed	Listed	Non-Listed	Listed
Metalaxyl								
Hops	0.5	Ground	--	--	--	0.54	NC	NC
Fruiting Vegetables, Strawberry	1	Aerial	--	--	--	**1.08**	NC	NC
		Ground	--	0.12	0.26	**1.00**	NC	NC
Cranberry	1.8	Ground	--	0.21	0.47	**1.80**	NC	NC
Cole Crops, Cucurbit Vegetables, Leafy	2	Ground	<0.1	0.24	0.52	**2.0**	NC	NC

Vegetables, Lettuce, Root And Tuber Vegetables, Eggplant, Pepper, Tomato, Spinach								
Golf Course Turf, Ornamental Lawns And Turf, Ornamental Sod Farm (Turf), Recreation Area Lawns	2.7	Ground	<0.1	0.32	0.70	**2.70**	NC	NC
Papaya	3.6	Ground	011	0.42	0.93	**3.60**	NC	NC
Citrus (Trees)	4.0	Aerial	0.20	0.78	**1.12**	**4.31**	NC	NC
		Ground	0.12	0.47	**1.04**	**4.00**	NC	NC
Avocado, Deciduous Fruit Trees (Unspecified), Stone Fruits, Tree Nuts	4.1	Aerial	0.21	0.80	**1.14**	**4.42**	NC	NC
		Ground	0.12	0.48	**1.06**	**4.10**	NC	NC
Citrus (Nursery stock)	10.2	Ground	0.31	**1.20**	**2.64**	**10.20**	NC	NC
Mefenoxam								
Broccoli, Chinese Broccoli, Brussels Sprouts, Cabbage, Chinese Cabbage, Cauliflower	0.062494	Aerial	NC	--	NC	--	--	--
		Ground	NC	--	NC	--	--	--
Bulb Vegetables	0.065528	Ground	NC	--	NC	--	--	--
Garlic	0.1	Aerial	NC	--	NC	--	--	--
Beans (succulent, snap), Caneberries, Garlic, Pepper, Radish, Potato		Ground	NC	--	NC	--	--	--
Leek, Shallot	0.104	Aerial	NC	--	NC	--	--	--
		Ground	NC	--	NC	--	--	--
Melons, Pumpkin, Squash, Cucumber	0.135	Aerial	NC	--	NC	--	--	--
		Ground	NC	--	NC	--	--	--
Hops	0.25	Ground	NC	--	NC	--	--	--
Kiwi	0.35	Ground	NC	--	NC	--	--	--
Ginseng	0.38	Ground	NC	--	NC	--	--	--
Legume Vegetables, Fruiting Vegetables	0.5	Aerial	NC	--	NC	--	--	--
Legume Vegetables, Fruiting Vegetables, Strawberry		Ground	NC	--	NC	--	--	--
Turf	0.68	Ground	NC	--	NC	--	--	--
Cranberry	0.88	Ground	NC	--	NC	--	--	--
Carrots, Cucurbit Vegetables, Leafy Vegetables, Cole Crops, Tomato	1	Aerial	NC	--	NC	--	--	--
Carrots, Cucurbit Vegetables, Leafy Vegetables, Cole Crops, Spinach, Herbs, Tomato		Ground	NC	--	NC	--	--	--
Subtropical fruit, Tobacco	1.5	Ground	NC	--	NC	--	--	--
Blueberry, Bush Berries,	1.81	Aerial	NC	--	NC	--	--	--
Blueberry, Bush Berries, Raspberry		Ground	NC	--	NC	--	--	--
Orchards (Unspecified), Stone Fruits, Tree Nuts, Avocado, Citrus,	2	Ground	NC	--	NC	--	--	--

Deciduous Fruit Trees (Unspecified)								
Citrus	2	Aerial	NC	<0.1	NC	0.33	<0.1	<0.1

-- indicates that RQ is below the LOC and is not included for clarity
Bolded values meet or exceed the LOC for listed and non-listed species (= 1.0)

6.3. Risk Conclusions

Because metalaxyl is applied at rates that are generally double those of mefenoxam, risk concerns from metalaxyl are generally greater than those for use of mefenoxam on the same crop.

Risk Conclusions- Metalaxyl

Fish: No risk concerns were identified for freshwater of estuarine/marine fish from acute or chronic exposure. Risk concerns for listed freshwater fish were identified based on acute exposure to spray drift deposition of the formulated product Ridomil 2E-G, which shows enhanced toxicity relative to metalaxyl TGAI, at the highest aerial application rates for deciduous fruit trees and citrus. As the formulated product Ridomil 2E-G is not be registered for use, the reality of these risk concerns are uncertain.

Aquatic Invertebrates: Risk concerns to freshwater invertebrates from acute and chronic exposure was only identified for exposure to undiluted cranberry bog water, and due to the slow hydrolysis rate and limited soil partitioning of metalaxyl, a holding period of up to 30 days is not sufficient to eliminate this risk concerns. RQs for acute exposure to estuarine/marine invertebrates reached the LOC for acute exposure to listed species, but the LOC was exceeded only for exposure to undiluted bog water. Refinements to the cranberry model are not currently available. To the extent that residues from cranberry bog water are diluted via mixing with waters from other (uncontaminated) sources upon release, the exposure to non-target organisms is likely to be overestimated by the Provisional Cranberry Model EECs. Risk concerns were identified for chronic exposure to estuarine/marine invertebrates based on EECs for runoff and spray drift that meet or exceed the aerial application rate for citrus (4 applications at 4 lbs ai/A), which includes undiluted cranberry bog water. Risk concerns for listed estuarine/marine invertebrates were identified based on acute spray-drift exposure to the formulated product Ridomil 2E-G, which shows enhanced toxicity relative to metalaxyl TGAI. Ridomil 2E-G does not currently have active registrations so reality of these risk concerns are uncertain.

Aquatic Plants: No risk concerns were identified for vascular of non-vascular aquatic plants from acute or chronic exposure.

Birds, Reptiles and Terrestrial-phase Amphibians: Acute risk concerns to listed species based on dietary exposure to seeds treated with metalaxyl were identified for application rates were identified for small and medium-sized birds for all uses greater than brassica (cole) leafy vegetables (0.0002 lb ai/lb seed). Acute risks to birds were identified for all aerial and ground application rates greater than hops (3x0.5 lbs ai/A). The highest acute RQ (=4.62) was calculated for use as a soil drench on citrus nursery stock. Chronic risk concerns were identified for listed and non-listed species at seed treatment application rates equal to or greater than corn, sorghum

and proso millet. Chronic risks to listed and non-listed bird species from foliar and/or ground application were identified for uses higher than cranberry (3x1.8 lbs ai/A). The highest chronic RQ (=3.18) was calculated based on the citrus nursery stock use.

Mammals: Acute risk to listed herbivorous and insectivorous mammals were identified for seed treatment uses than for sweet corn (0.000075 lb/lb seed). Acute risk concerns to listed species from spray application were identified for all uses and risk to listed and non-listed species were identified for uses higher than cranberry (3x1.8 lbs ai/A). The highest mammalian acute RQ of 1.85 was identified for use as a soil drench on citrus nursery stock. Chronic risk concerns for listed and non-listed mammals were identified for seed treatment uses above the application rate for sweet corn (0.000075 lb/lb seed) and all aerial/ground spray uses. The highest chronic RQ of 19.85 was calculated based on the use rate for soil drench application to citrus nursery stock. As no reproductive effects were observed in the chronic mammalian toxicity test, the likelihood of chronic risk to mammals is uncertain.

Terrestrial Invertebrates: No risk concerns were identified for honeybees based on contact exposure. Risk from dietary exposure is unknown. However, since metalaxyl is systemic and registered uses include pollinator attractive crops, additional data on adult and larval bees based on oral/dietary exposure could help address the uncertainty related to its toxicity to terrestrial invertebrates.

Terrestrial Plants: Risk concerns exist for listed and non-listed monocots at use rates greater than cranberry (3x1.8 lbs ai/A) and for dicots at application rates greater than those for hops (3x1.5 lb ai/A). The highest RQs for monocots (RQ=5.20) and dicots (RQ=10.2) were calculated based on use on citrus nursery stock.

Risk Conclusions- Mefenoxam

Existing uses

Fish: No risk concerns were identified for freshwater of estuarine/marine fish from acute or chronic exposure.

Aquatic Invertebrates: No risk concerns were identified for freshwater or estuarine/marine invertebrates.

Aquatic Plants: No risk concerns were identified for non-vascular aquatic plants from acute or chronic exposure. No risk concerns for non-listed species of aquatic plants were identified, but based on uncertainty related to NOAEC value for vascular aquatic plants, risk could not be precluded for this taxa.

Birds, reptiles and terrestrial-phase amphibians: Acute risk concerns to listed birds were identified for listed species at rates higher than those for beans and caneberries (2x0.1 lbs ai/A). Acute risks to non-listed birds were identified for use rates greater than legume vegetables (1x0.5 lbs ai/A). No acute or chronic risk concerns for existing or proposed seed treatment uses were identified. No chronic risk concerns were identified only for spray application rates.

Mammals: No acute or chronic risk concerns were identified for mammals based upon existing or proposed seed treatment uses. Acute risk concerns to listed species exist for spray application rates greater than legume vegetables, while no risk concerns for non-listed species were identified. Chronic dose-based risk from spray application exists for all uses greater than hops (1x0.25 lbs ai/A). The highest mammalian RQ was calculated for chronic exposure based on the application rates for blueberries, bush berries and raspberries (RQ=5.64). As no reproductive effects were observed in the chronic mammalian study, the likelihood of observing effects in mammals following chronic exposure to metalaxyl and mefenoxam is uncertain.

Terrestrial Invertebrates: No risk concerns were identified for honeybees based on acute contact exposure. Risk from dietary exposure is unknown. However, since metalaxyl is systemic and registered uses include pollinator attractive crops, additional data on adult and larval bees based on oral/dietary exposure could help address the uncertainty related to its toxicity to terrestrial invertebrates.

Terrestrial Plants: Risk concerns exist for monocots based on single application rates greater than those for subtropical fruits and tobacco (1.5 lbs ai/A), while no risk concerns were identified for dicot plants. The highest monocot (RQ=1.10) and dicot (RQ=0.33) RQs were calculated based on aerial application to citrus trees. Nine incidents reported for mefenoxam involve effects to plants.

Proposed Crop Group Conversion

No risk concerns are identified for terrestrial species based on the proposed crop group conversion. The only risk concern for aquatic species is for listed algae. As a reduction in the number of fronds was observed in the test with the non-vascular aquatic species, *Lemna gibba*, risk to listed species of aquatic plants could not precluded for this proposed action.

7. Listed Species of Concern

In November 2013, the EPA, along with the U.S. Fish & Wildlife Service (USFWS), the National Marine Fisheries Service (NMFS) (collectively, the Services), and the U.S. Department of Agriculture (USDA) released a summary of their joint Interim Approaches for assessing risks to listed species from pesticides. The Interim Approaches were developed jointly by the agencies in response to the National Academy of Sciences' (NAS) recommendations and reflect a common approach to risk assessment shared by the agencies as a way of addressing scientific differences between the EPA and the Services. The NAS report outlines recommendations on specific scientific and technical issues related to the development of pesticide risk assessments that EPA and the Services must conduct in connection with their obligations under the Endangered Species Act (ESA) and FIFRA.

The joint Interim Approaches were released prior to a stakeholder workshop held on November 15, 2013. In addition, the EPA presented the joint Interim Approaches at the December 2013 Pesticide Program Dialogue Committee (PPDC) and State-FIFRA Issues

Research and Evaluation Group (SFIREG) meetings, and held a stakeholder workshop in April 2014, allowing additional opportunities for stakeholders to comment on the Interim Approaches. As part of a phased, iterative process for developing the Interim Approaches, the agencies will also consider public comments on the Interim Approaches in connection with the development of upcoming Registration Review decisions. The details of the joint Interim Approaches are contained in the white paper "Interim Approaches for National-Level Pesticide Endangered Species Act Assessments Based on the Recommendations of the National Academy of Sciences April 2013 Report," dated November 1, 2013.

Given that the agencies are continuing to develop and work toward implementation of the Interim Approaches to assess the potential risks of pesticides to listed species and their designated critical habitat, this preliminary risk assessment for metalaxyl and mefenoxam does not contain a complete ESA analysis that includes effects determinations for specific listed species or designated critical habitat. Although EPA has not yet completed effects determinations for specific species or habitats, for this preliminary assessment EPA conducted an assessment for all taxa of non-target wildlife and plants that assumes for the sake of the assessment that listed species and designated critical habitats may be present in the vicinity of the application of metalaxyl and mefenoxam. This assessment will allow EPA to focus its future evaluations on the types of species where the potential for effects exists. This risk assessment for metalaxyl and mefenoxam indicates potential risks of direct effects to listed estuarine/marine invertebrates, freshwater fish, birds, reptiles, terrestrial-phase amphibians, and terrestrial plants. Once the agencies have fully developed and implemented the scientific methods necessary to complete risk assessments for endangered and threatened (listed) species and their designated critical habitats, these methods will be applied to subsequent analyses for metalaxyl and mefenoxam as part of completing this registration review.

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USEPA, 2014. Guidance for Assessing Pesticide Risks to Bees. U.S. Environmental Protection Agency, Office of Pesticide Programs, Environmental Fate and Effects Division, June 23, 2014.

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8.1. Submitted Environmental Fate and Product Chemistry Studies

MRID	Citation Reference
104493	Burkhard, N. (1976) Hydrolysis of CGA-48988 under Laboratory Conditions: Project Report 26/76. (Unpublished study received Jul 13, 1978 under 100-EX-62; prepared by Ciba-Geigy, Ltd., Switz., submitted by Ciba-Geigy Corp., Greensboro, NC; CDL: 234438-C)
41156001	Martinson, J. (1988) Photodegradation of Aqueous Solutions of Metalaxyl Exposed to Natural Sunlight: SLS Report No. 88-09-2799. Unpublished study prepared by Springborn Life Sciences, Inc. 32 p.
43883402	Sparrow, K. (1995) Photodegradation of (carbon 14)-CGA-329351 on Soil Under Artificial Light: Lab Project Number: ABR-95094: 151-95. Unpublished study prepared by Ciba Crop Protection. 199 p.
43935301	Fathulla, R. (1996) Aerobic Soil Metabolism of (Carbon 14)-CGA-329351 in a Sandy Loam Soil: (Amended Final Report): Lab Project Number: HWI 6117-280: 58-95: TX-94-0317. Unpublished study prepared by Hazleton Wisconsin, Inc. 363 p.
43935302	Fathulla, R. (1996) Column Leaching Characteristics of Aged (Carbon 14)-CGA-329351 in Four Soil Types: Lab Project Number: 61-95: CHW 6117-284: 6117-284. Unpublished study prepared by Corning Hazleton Inc. 720 p
42259801	Vithala, R. (1992) Anaerobic Aquatic Metabolism of ?carbon 14|-Metalaxyl: Amended Final Report: Lab Project Number: 005/001/007/89. Unpublished study prepared by Center for Hazardous Materials Research. 229 p.
47886102	Mondel, M. (2003) Mefenoxam: Degradation of CGA329351 in Soil "Pappelacker": Final Report. Project Number: SYN04, T002133/08. Unpublished study prepared by Service Center for the Rural Region Rheinpfalz. 48 p.
47886103	Dorn, R. (2002) Mefenoxam: Adsorption/Desorption of CGA329351 in Four Soils: Final Report. Project Number: NOV08, T002136/08. Unpublished study prepared by State Academy and Research Institute for Agriculture, Viniculture and Horticulture. 83 p.
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42259802 Vithala, R. (1991) Aerobic Aquatic Metabolism of ?carbon 14|-Metalaxyl: Lab Project Number: 005/002/008/89. Unpublished study prepared by Center for Hazardous Materials Research. 130 p.

40985403 Jones, P. (1988) Field Dissipation Study on Ridomil 5G on Bare Ground: Madera, California: Laboratory Study No. 87031. Unpub- lished study prepared by Pan-Agricultural Laboratories, Inc. 208 p.

40985404 Jones, P. (1989) Field Dissipation Study on Ridomil 5G Tomatoes Madera, California: Laboratory Study No. 87031. Unpublished study prepared by Pan-Agricultural Laboratories, Inc. 209 p.

41765001 LeRoy, R. (1991) Terrestrial Field Dissipation of Ridomil 2E on Bare Ground: Lab Project Number: EF-88-04B: 80202. Unpublished Study prepared by Pan-Agricultural Laboratories, Inc. & ChemAlysis Inc. 234 p.

41765002 Braxton, S.; Bird, R. (1991) Ridomil 2E-Field Dissipation-Tobacco and Bare Soil-North Carolina: Lab Project Number: 23TBBS. Unpublished study prepared by Environmental Technologies Institute & ChemAlysis Laboratories. 491 p.

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42259803 Leech, G.; Wiepke, T. (1992) Aquatic Dissipation of Metalaxyl (Ridomil 2E) in a California Rice Paddy: Lab Project Number: EF-90-326: 31/90-CGA.1. Unpublished study prepared by Pan-Agricultural Laboratories, Inc. and Twin City Testing Corp. 272 p.

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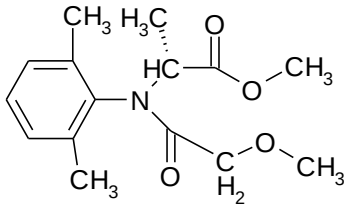
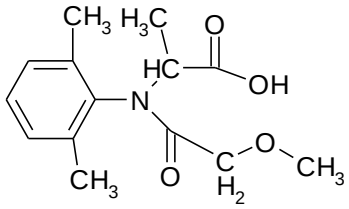
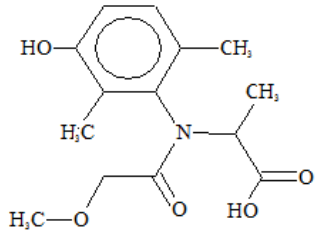
100468 Ladd, S.; Wilson, W. (1979) Accumulation and Elimination of 14C- residues by Bluegill Sunfish ... Exposed to 0-14C-CGA-48988: Report #BW-78-10-328. (Unpublished study received Apr 26, 1979 under 100-600; prepared by EG & G, Bionomics; submitted by Ciba-Geigy Corp., Greensboro, NC; CDL:238232-E)

Appendix A. Metalaxyl/Mefenoxam and Its Major Environmental Degradates

Metalaxyl/Mefenoxam and Its Major Environmental Degradates

Code Name/ Synonym	Chemical Name	Chemical Structure	Study Type	Ref. (MRID)	Maximum %AR (day)[A]	Final %AR (study length)
PARENT						
Metalaxyl / Mefenoxam **SMILES:** COCC(=O)N(c1c(C)cccc1C)[C@H](C)C(=O)OC	Methyl N-(2,6-dimethylphenyl)-N-(methoxyacetyl)-D-alaninate **CAS No.:** 70630-17-0 **Formula:** $C_{15}H_{21}NO_4$ **MW:** 279.34 g/mole					
MAJOR TRANSFORMATION PRODUCTS						

Code Name/ Synonym	Chemical Name	Chemical Structure	Study Type	Ref. (MRID)	Maximum %AR (day)[A]	Final %AR (study length)
CGA 62826 (or NOA 409045) **SMILES:** OCC(=O)N(c1c(C)cccc1C)[C@H](C)C(=O)OC	N-(2,6-Dimethylphenyl)-N-(methoxyacetyl)-alanine **Formula:** $C_{14}H_{19}NO_4$ **MW:** 265.31 g/mol		Aq photolysis	41156001	5.7% (14 d)	5.7% (14 d)
			Aerobic aquatic	42259802	20.6% (30 d)	20.6% (30 d)
				47886101	74.1% (181 d) 87.8% (112 d)	71.5% (240 d) 76.3% (240 d)
			Anaerobic aquatic	42259801	85.53% (265 d)	48.07% (385 d)
			Aerobic Soil	00104494 43935301 47886102 47886104	53.6% (66 d) 78% (130 d) 27.6% (14 d) 38.6% (63 d)	25% (360 d) 72% (160 d) 0.3% (119 d) 33.8% (119 d)
			Terr dissipation [C]	40985403 40985404 41765001 41765002 41809301	25% (30 d) 57% (30 d) 22% (1 d) 10% (9 d) 66% (28 d)	5% (336 d) 3% (336 d) <1% (548 d) <2% (534 d) <1% (548 d)
			Aq dissipation [D]	42259803 42259804	23% (7 d) 7.7% (1 d)	n.d [B] (259 d) n.d [B] (367 d)
CGA 119857 (in anaerobic conditions) **SMILES:** CC1=C(C(=C(O)C=C1)C)N([C@H](C)C(=O)O)C(=O)COC	N-(3_hydroxy-2, 6-dimethylphenyl)-N-(methoxyacetyl)-L-alanine **Formula:** $C_{14}H_{19}NO_5$ **MW:** 281.31 g/mol		Anaerobic aquatic	42259801	16.25% (385 d)	16.25% (385 d)
Unextracted Residues	Unknown	-	Aerobic Soil	00104494 43935301-1 43935301-2 47886102 47886104	38.3% (360 d) 4.3% (160 d) 4.7% (130 d) 53.8% (43 d) 32.4% (119)	38.3% (360 d) 4.3% (160 d) 1.3% (160 d) 50.9% (119 d) 32.4% (119 d)

[A] Bolded values indicate a major degradate was formed or that a degradate is of toxicological significance

[B] n.d. means "not detected".

[C] Terrestrial field study percentages represent the ratio of degradate concentration to the maximum parent concentration, both in the top layer of soil.

[D] Aquatic field study percentages represent the ratio of degradate concentration to the maximum parent concentration, both in the top layer of sediment .

Appendix B. Sample PWC Output

1. Summary of Water Modeling of Metalaxyl and the USEPA Standard Pond

Estimated Environmental Concentrations for Metalaxyl are presented in Table 1 for the USEPA standard pond with the MICherriesSTD field scenario. A graphical presentation of the year-to-year peaks is presented in Figure 1. These values were generated with the Pesticide Water Calculator (PWC), Version 1.52. Critical input values for the model are summarized in Tables 2 and 3.

This model estimates that about 1.9% of Metalaxyl applied to the field eventually reaches the water body. The main mechanism of transport from the field to the water body is by spray drift (67.2% of the total transport), followed by runoff (30.1%) and erosion (2.69%).

In the water body, pesticide dissipates with an effective water column half-life of 2167.3 days. (This value does not include dissipation by transport to the benthic region; it includes only processes that result in removal of pesticide from the complete system.) The main source of dissipation in the water column is metabolism (effective average half-life = 2167.6 days) followed by volatilization (1.653783E+07 days).

In the benthic region, pesticide dissipation is negligible (3995.0 days). The main source of dissipation in the benthic region is metabolism (effective average half-life = 3995 days). The vast majority of the pesticide in the benthic region (97.79%) is sorbed to sediment rather than in the pore water.

Table 1. Estimated Environmental Concentrations (ppb) for Metalaxyl.

Peak (1-in-10 yr)	852.
4-day Avg (1-in-10 yr)	851.
21-day Avg (1-in-10 yr)	846.
60-day Avg (1-in-10 yr)	838.
365-day Avg (1-in-10 yr)	827.
Entire Simulation Mean	559.

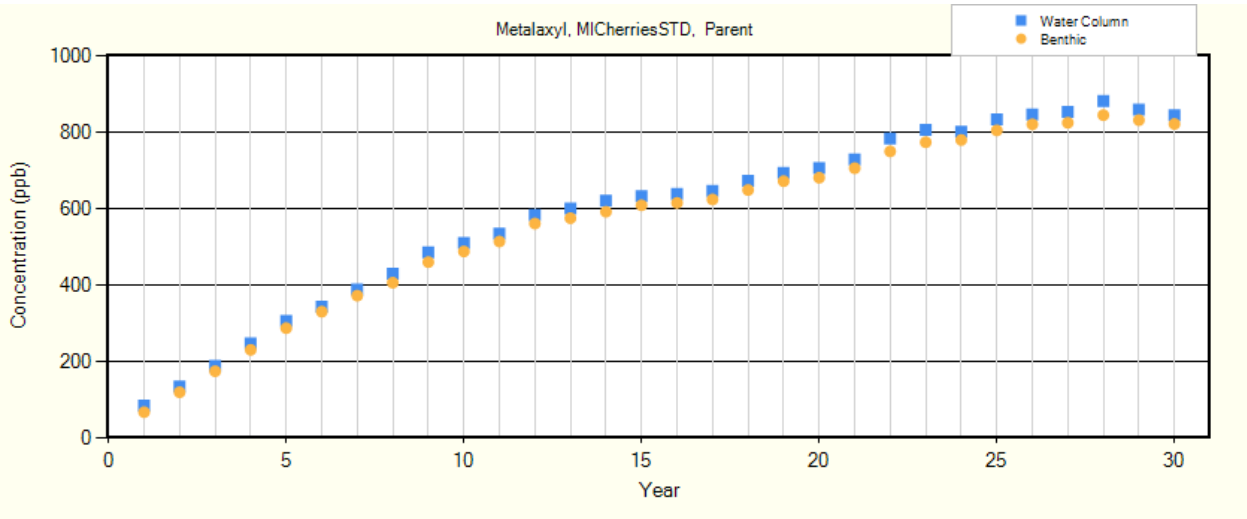
Table 2. Summary of Model Inputs for Metalaxyl.

Scenario	MICherriesSTD
Cropped Area Fraction	1
Koc (ml/g)	409
Water Half-Life (days) @ 25 °C	790
Benthic Half-Life (days) @ 25 °C	1456
Photolysis Half-Life (days) @ 40 °Lat	0
Hydrolysis Half-Life (days)	0
Soil Half-Life (days) @ 20 °C	3233
Foliar Half-Life (days)	
Molecular Weight	279.34
Vapor Pressure (torr)	2.2e-6
Solubility (mg/l)	26000
Henry's Constant	8.05E-10

Table 3. Application Schedule for Metalaxyl.

Date (Mon/Day)	Type	Amount (kg/ha)	Eff.	Drift
4/1	Above Crop (Foliar)	4.59	0.95	.125
7/1	Above Crop (Foliar)	4.59	0.95	.125
10/1	Above Crop (Foliar)	4.59	0.95	.125

Figure 1. Yearly Peak Concentrations



2. Summary of Water Modeling of Mefenoxam and the USEPA Standard Pond

Estimated Environmental Concentrations for Mefenoxam are presented in Table 1 for the USEPA standard pond with the MICherriesSTD field scenario. A graphical presentation of the year-to-year peaks is presented in Figure 1. These values were generated with the Pesticide Water Calculator (PWC), Version 1.52. Critical input values for the model are summarized in Tables 2 and 3.

This model estimates that about 1.9% of Mefenoxam applied to the field eventually reaches the water body. The main mechanism of transport from the field to the water body is by spray drift (67.2% of the total transport), followed by runoff (30.1%) and erosion (2.69%).

In the water body, pesticide dissipates with an effective water column half-life of 2167.3 days. (This value does not include dissipation by transport to the benthic region; it includes only processes that result in removal of pesticide from the complete system.) The main source of dissipation in the water column is metabolism (effective average half-life = 2167.6 days) followed by volatilization (1.653783E+07 days).

In the benthic region, pesticide dissipation is negligible (3995.0 days). The main source of dissipation in the benthic region is metabolism (effective average half-life = 3995 days). The vast majority of the pesticide in the benthic region (97.79%) is sorbed to sediment rather than in the pore water.

Table 1. Estimated Environmental Concentrations (ppb) for Mefenoxam.

Peak (1-in-10 yr)	416.
4-day Avg (1-in-10 yr)	415.
21-day Avg (1-in-10 yr)	413.
60-day Avg (1-in-10 yr)	409.
365-day Avg (1-in-10 yr)	404.

Entire Simulation Mean	273.

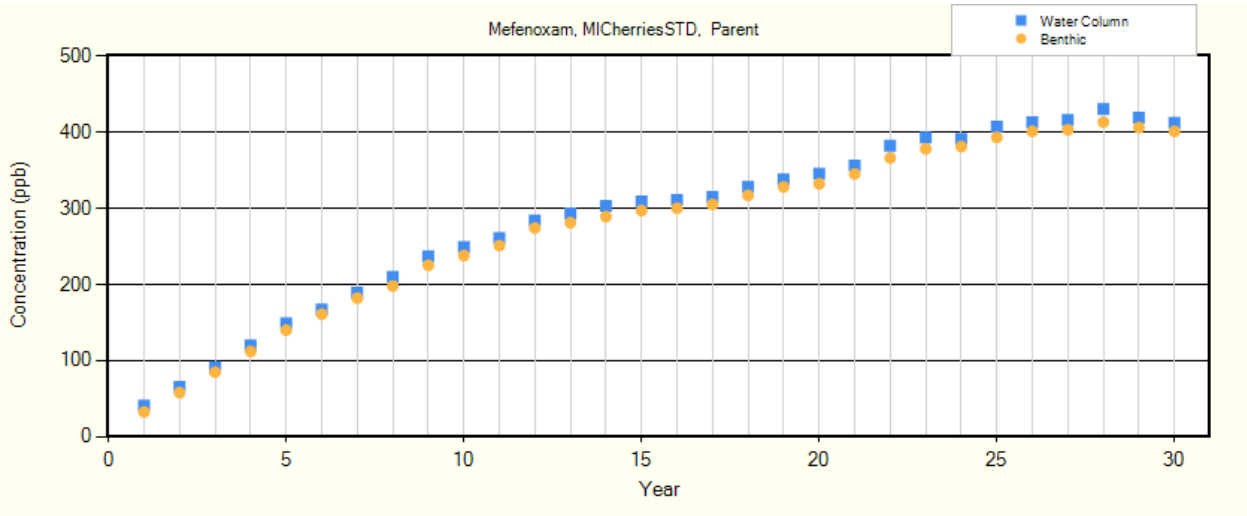
Table 2. Summary of Model Inputs for Mefenoxam.

Scenario	MICherriesSTD
Cropped Area Fraction	1
Koc (ml/g)	409
Water Half-Life (days) @ 25 °C	790
Benthic Half-Life (days) @ 25 °C	1456
Photolysis Half-Life (days) @ 40 °Lat	0
Hydrolysis Half-Life (days)	0
Soil Half-Life (days) @ 20 °C	3233
Foliar Half-Life (days)	
Molecular Weight	279.34
Vapor Pressure (torr)	2.2e-6
Solubility (mg/l)	26000
Henry's Constant	8.05E-10

Table 3. Application Schedule for Mefenoxam.

Date (Mon/Day)	Type	Amount (kg/ha)	Eff.	Drift
4/1	Above Crop (Foliar)	2.24	0.95	.125
7/1	Above Crop (Foliar)	2.24	0.95	.125
10/1	Above Crop (Foliar)	2.24	0.95	.125

Figure 1. Yearly Peak Concentrations



Appendix C. SIP Outputs

Table 1. Inputs

Parameter	Value
Chemical name	mefenoxam
Solubility (in water at 25°C; mg/L)	7100
Mammalian LD_{50} (mg/kg-bw)	1269
Mammalian test species	laboratory rat
Body weight (g) of "other" mammalian species	
Mammalian NOAEL (mg/kg-bw)	62.5
Mammalian test species	laboratory rat
Body weight (g) of "other" mammalian species	
Avian LD_{50} (mg/kg-bw)	981
Avian test species	northern bobwhite quail
Body weight (g) of "other" avian species	
Mineau scaling factor	1.15
Mallard NOAEC (mg/kg-diet)	900
Bobwhite quail NOAEC (mg/kg-diet)	900

Table 2. Mammalian Results

Parameter	Acute	Chronic
Upper bound exposure (mg/kg-bw)	1221.2000	1221.2000
Adjusted toxicity value (mg/kg-bw)	976.0648	48.0725
Ratio of exposure to toxicity	1.2511	25.4033
Conclusion*	**Exposure through drinking water alone is a potential concern for mammals**	**Exposure through drinking water alone is a potential concern for mammals**

Table 3. Avian Results

Parameter	Acute	Chronic
Upper bound exposure (mg/kg-bw)	5751.0000	5751.0000
Adjusted toxicity value (mg/kg-bw)	706.7414	44.6513
Ratio of exposure to acute toxicity	8.1373	128.7980
Conclusion*	**Exposure through drinking water alone is a potential concern for birds**	**Exposure through drinking water alone is a potential concern for birds**

*Conclusion is for drinking water exposure alone. This does not combine all routes of exposure. Therefore, when aggregated with other routes (*i.e.*, diet, inhalation, dermal), pesticide exposure through drinking water may contribute to a total exposure that has potential for effects to non-target animals.

Table 1. Inputs

Parameter	Value
Chemical name	Metalaxyl
Solubility (in water at 25°C; mg/L)	7100
Mammalian LD_{50} (mg/kg-bw)	669
Mammalian test species	laboratory rat
Body weight (g) of "other" mammalian species	
Mammalian NOAEL (mg/kg-bw)	62.5
Mammalian test species	laboratory rat
Body weight (g) of "other" mammalian species	
Avian LD_{50} (mg/kg-bw)	694
Avian test species	other
Body weight (g) of "other" avian species	18.1
Mineau scaling factor	1.15
Mallard NOAEC (mg/kg-diet)	900
Bobwhite quail NOAEC (mg/kg-diet)	900
NOAEC (mg/kg-diet) for other bird species	
Body weight (g) of other avian species	
NOAEC (mg/kg-diet) for 2nd other bird species	
Body weight (g) of 2nd other avian species	

Enter body weight of 'other' avian species for LD50.

Table 2. Mammalian Results

Parameter	Acute	Chronic
Upper bound exposure (mg/kg-bw)	1221.2000	1221.2000
Adjusted toxicity value (mg/kg-bw)	514.5684	48.0725
Ratio of exposure to toxicity	2.3733	25.4033
Conclusion*	**Exposure through drinking water alone is a potential concern for mammals**	**Exposure through drinking water alone is a potential concern for mammals**

Table 3. Avian Results

Parameter	Acute	Chronic
Upper bound exposure (mg/kg-bw)	5751.0000	5751.0000
Adjusted toxicity value (mg/kg-bw)	704.4695	44.6513
Ratio of exposure to acute toxicity	8.1636	128.7980
Conclusion*	**Exposure through drinking water alone is a potential concern for birds**	**Exposure through drinking water alone is a potential concern for birds**

*Conclusion is for drinking water exposure alone. This does not combine all routes of exposure. Therefore, when aggregated with other routes (*i.e.*, diet, inhalation, dermal), pesticide exposure through drinking water may contribute to a total exposure that has potential for effects to non-target animals.

Appendix D. STIR Outputs

Input		
Application and Chemical Information		****NOTE**:** When entering values, pres in order to update linked cells.
Enter Chemical Name	Metalaxyl	
Enter Chemical Use	Fungicide	
Is the Application a Spray? (enter y or n)	y	
If Spray What Type (enter ground or air)	air	
Enter Chemical Molecular Weight (g/mole)	279.3	
Enter Chemical Vapor Pressure (mmHg)	2.20E-06	
Enter Application Rate (lb a.i./acre)	5.3	
Toxicity Properties		
Bird		
Enter Lowest Bird Oral LD_{50} (mg/kg bw)	694	
Enter Mineau Scaling Factor	1.15	
Enter Tested Bird Weight (kg)	0.0181	
Mammal		
Enter Lowest Rat Oral LD_{50} (mg/kg bw)	669	
Enter Lowest Rat Inhalation LC_{50} (mg/L)	4	
Duration of Rat Inhalation Study (hrs)	4	
Enter Rat Weight (kg)	0.35	

Output		
Results Avian (0.020 kg)		
Maximum Vapor Concentration in Air at Saturation (mg/m^3)	3.31E-02	
Maximum 1-hour Vapor Inhalation Dose (mg/kg)	4.16E-03	
Adjusted Inhalation LD_{50}	3.26E+01	
Ratio of Vapor Dose to Adjusted Inhalation LD_{50}	1.28E-04	**Exposure not Likely Significant**
Maximum Post-treatment Spray Inhalation Dose (mg/kg)	5.09E-01	
Ratio of Droplet Inhalation Dose to Adjusted Inhalation LD_{50}	1.56E-02	**Exposure not Likely Significant**
Results Mammalian (0.015 kg)		
Maximum Vapor Concentration in Air at Saturation (mg/m^3)	3.31E-02	
Maximum 1-hour Vapor Inhalation Dose (mg/kg)	5.23E-03	
Adjusted Inhalation LD_{50}	2.38E+02	
Ratio of Vapor Dose to Adjusted Inhalation LD_{50}	2.19E-05	**Exposure not Likely Significant**
Maximum Post-treatment Spray Inhalation Dose (mg/kg)	6.40E-01	
Ratio of Droplet Inhalation Dose to Adjusted Inhalation LD_{50}	2.69E-03	**Exposure not Likely Significant**

Appendix E. Ecological Incidents Associated with Mefenoxam and Metalaxyl

Incident ID	Type	Total Magnitude	State	Year	Legality
Metalaxyl					
B0000-300-45	Aquatic- Mullet	NR	SC	1984	Undetermined
I000022-001	Terrestrial- Bluebird	1 Individual	VA	1992	Undetermined
I000116-001	Aquatic-Unknown Fish	1000 Fish	DE	1992	Undetermined
I022069-001	Aquatic	NR	PE-Canada	NR	Undetermined
I022069-002	Aquatic	NR	PE-Canada	NR	Undetermined
I023967-001	Terrestrial	1346 hives	MN	2012	Undetermined
Mefenoxam					
I010837-012	Plants- Cotton	655 acres of 690	SC	2000	Registered use
I014597-041	Plants-Beans green/snap	75 acres	MI	2003	Registered use
I014597-042	Plants-Citrus	80 acres	FL	2003	Registered use
I022450-009	Plants- Soybean	50% of 80 acres	NE	2009	Undetermined
I023444-007	Plants- Potato	30 acres	ME	2011	Undetermined
I023444-008	Plants- Potato	53% of 1,135 Acres	ME	2011	Undetermined
I023444-009	Plants- Potato	23 acres	ME	2011	Undetermined
I023444-010	Plants- Potato	350 acres	ME	2011	Undetermined
I023444-011	Plants- Potato	50 acres	ME	2011	Undetermined

Appendix F. T-REX Model Inputs and Outputs

Input Parameters for Deriving Screening-Level Terrestrial EECs for Foliar Applications of Metalaxyl and Mefenoxam (T-REX v. 1.5.2; June 6, 2013)

Use(s)	Maximum Single App. Rate (lbs ai/A)	Minimum Reapplication Interval (days)	Maximum No. of App.[1]	Foliar Dissipation Half-Life
Metalaxyl				
Hops	0.5	14	3	35[2]
Fruiting Vegetables, Strawberry	1	17	3	
Cranberry	1.8	14	3	
Cole Crops, Cucurbit Vegetables, Leafy Vegetables, Lettuce, Root And Tuber Vegetables	2	NA	1	
Eggplant, Pepper, Tomato, Spinach	2	17	2	
Golf Course Turf, Ornamental Lawns And Turf, Ornamental Sod Farm (Turf), Recreation Area Lawns	2.7	17	3	
Papaya	3.6	14	2	
Citrus (Trees)	4	90	3	
Avocado, Deciduous Fruit Trees (Unspecified), **Stone Fruits, Tree Nuts**	4.1	90	3	
Citrus (Nursery stock)	10.2	90	2 *assumed	
Mefenoxam				
Broccoli, Chinese Broccoli, Brussels Sprouts, Cabbage, Chinese Cabbage, Cauliflower	0.062494	14	8	35[2]
Bulb Vegetables	0.065528	NA	(1 CC) 1[3]	
Beans (succulent, snap), Caneberries	0.1	7	2	
Garlic	0.1	7	5	
Pepper, Radish	0.1	7	4	
Potato	0.1	14	2	
Leek, Shallot	0.104	7	3	
Melons, Pumpkin, Squash, Cucumber	0.135	10	4	
Hops	0.25	NA	1	
Kiwi	0.35	30	(5 CC) 5	
Ginseng	0.38	30	4	
Legume Vegetables	0.5	NA	1	
Fruiting Vegetables Strawberry	0.5	7	(3 CC) 3	
Turf	0.68	7	(3 CC) 3	
Cranberry	0.88	7	(3 CC) 3	
Carrots, Cucurbit Vegetables, Leafy Vegetables, Cole Crops, **Spinach**	1	NA	1	
Herbs, **Tomato**	1	7	2	

Use(s)	Maximum Single App. Rate (lbs ai/A)	Minimum Reapplication Interval (days)	Maximum No. of App.[1]	Foliar Dissipation Half-Life
Subtropical fruit	1.5	7	(2 CC) 2	
Tobacco	1.5	NA	1	
Blueberry, Bush Berries, Raspberry	1.81	7	(2 CC) 2	
Orchards (Unspecified), Stone Fruits, Tree Nuts, Avocado	2	60	3	
Citrus	2	90	3	

[1] The maximum number of applications at the maximum single application rate, based on the maximum annual application rate. Values are rounded up to the next higher integer. The last application is modeled at a lower rate when necessary to avoid exceeding the maximum annual application rate.
[2] The default foliar dissipation half-life value of 35 days is used in the absence of foliar dissipation data.
[3] Number of applications are specified in terms of crop cycle are provided in parenthesis. One crop cycle per year is assumed.

Appendix G. Sample T-REX Inputs and Outputs

Chemical Identity and Application Information

Chemical Name:	Metalaxyl
Seed Treatment? (Check if yes)	☐ FALSE
Use:	Cranberry
Product name and form:	
% A.I. (leading zero must be entered for formulations <1% a.i.):	100.00%
Application Rate (lb ai/acre)	1.8
Half-life (days):	35
Application Interval (days):	14
Number of Applications:	3
Are you assessing applications with variable rates or intervals?	no

Assessed Species Inputs (optional, use defaults for RQs for national level assessments)

What body weight range is assessed (grams)?	Birds	Mammals
Small	20	15
Medium	100	35
Large	1000	1000

Avian

Endpoint	Toxicity value	Indicate test species below	Optional Test Organism Body weight (g)	Optional Test Species Name
LD50 (mg/kg-bw)	694.00	Other	18.10	canary
LC50 (mg/kg-diet)		Bobwhite quail		
NOAEL (mg/kg-bw)		Bobwhite quail		
NOAEC (mg/kg-diet)	900.00	Bobwhite quail		

Enter the Mineau et al. Scaling Factor 1.15

Mammalian

		Acute Study	Chronic Study
Size (g) of mammal used in toxicity study Default rat body weight is 350 grams		350	350
Endpoint	Toxicity value		Reference (MRID)
LD50 (mg/kg-bw)	669.00		
LC50 (mg/kg-diet)			
Reported Chronic Endpoint	1250.00	mg/kg-diet	
Is estimated daily dose (mg/kg-bw) reported from the available chronic mammal study? (yes or no)	no		

Chemical Identity and Application Information

Chemical Name:	Mefenoxam
Seed Treatment? (Check if yes)	☐ FALSE
Use:	Deciduous Fruit Trees
Product name and form:	
% A.I. (leading zero must be entered for formulations <1% a.i.):	100.00%
Application Rate (lb ai/acre)	4
Half-life (days):	35
Application Interval (days):	90
Number of Applications:	2
Are you assessing applications with variable rates or intervals?	no

Avian

Endpoint	Toxicity value	Indicate test species below
LD50 (mg/kg-bw)	694.00	Other
LC50 (mg/kg-diet)		Bobwhite quail
NOAEL (mg/kg-bw)		Bobwhite quail
NOAEC (mg/kg-diet)	900.00	Bobwhite quail

Optional Test Organism Body weight (g)	Optional Test Species Name
18.10	canary

Enter the Mineau et al. Scaling Factor 1.15

Mammalian

	Acute Study	Chronic Study
Size (g) of mammal used in toxicity study Default rat body weight is 350 grams	350	350

Endpoint	Toxicity value		Reference (MRID)
LD50 (mg/kg-bw)	1269.00		
LC50 (mg/kg-diet)			
Reported Chronic Endpoint	1250.00	mg/kg-diet	
Is estimated daily dose (mg/kg bw) reported from the available chronic mammal study? (yes or no)	no		

Estimated Chronic Daily Dose Equivalent to reported Chronic Dietary Endpoint	62.5	mg/kg-bw based on standard FDA lab rat conversion

Appendix H. TERRPLANT Model Inputs

TerrPlant v. 1.2.2

Green values signify user inputs (Tables 1, 2 and 4).

Input and output guidance is in popups indicated by red arrows.

Table 1. Chemical Identity.	
Chemical Name	**metalaxyl**
PC code	**113502**
Use	**citrus**
Application Method	**Aerial**
Application Form	**Spray**
Solubility in Water (ppm)	**7100**

Table 2. Input parameters used to derive EECs.			
Input Parameter	**Symbol**	**Value**	**Units**
Application Rate	A	**4.1**	**lbs ai/A**
Incorporation	I	**1**	none
Runoff Fraction	R	**0.05**	none
Drift Fraction	D	**0.05**	none

Table 3. EECs for metalaxyl . Units in lbs ai/A.		
Description	**Equation**	**EEC**
Runoff to dry areas	(A/I)*R	0.205
Runoff to semi-aquatic areas	(A/I)*R*10	2.05
Spray drift	**A*D**	**0.205**
Total for dry areas	**((A/I)*R)+(A*D)**	**0.41**
Total for semi-aquatic areas	**((A/I)*R*10)+(A*D)**	**2.255**

Table 4. Plant survival and growth data used for RQ derivation. Units are in lbs ai/A.				
	Seedling Emergence		**Vegetative Vigor**	
Plant type	**EC_{25}**	**NOAEC**	**EC_{25}**	**NOAEC**
Monocot	**1.6**	**1**		**4.1**
Dicot	**1.97**	**0.51**		**2**

Table 5. RQ values for plants in dry and semi-aquatic areas exposed to metalaxyl through runoff and/or spray drift.*				
Plant Type	**Listed Status**	**Dry**	**Semi-Aquatic**	**Spray Drift**
Monocot	non-listed	0.26	1.41	0.13
Monocot	listed	0.41	2.26	<0.1
Dicot	non-listed	0.21	1.14	0.10
Dicot	listed	0.80	4.42	0.10
*If RQ > 1.0, the LOC is exceeded, resulting in potential for risk to that plant group.				

Appendix I. Full List of Terrestrial and Aquatic EECs

Avian Estimated Exposure Concentrations (EECs) from Seed treatment Uses

Use	Product application rate (fl oz/CWT) and % ai	Available ai (mg ai/ft^2)	Nagy Dose-Based EECs (mg/kg-bw/day)		
			Small (20 g)	Medium (100 g)	Large (1000 g)
Metalaxyl					
Ornamental grasses	(3.4 fl oz/CWT) (0.82 % ai)	0.00	4.59	2.62	1.17
Flax	(4.6 fl oz/CWT) (1.26 % ai)	--	--	--	--
Cucumber, Mustard, Okra, Clary Sage, Beets (Unspecified), Onions (Green)	(0.75 fl oz/CWT) (28.35 % ai)	--	--	--	--
Brassica (Cole) Leafy Vegetables	(1.5 fl oz/CWT) (28.35 % ai)	--	--	--	--
Barley, Beans, Beans, Dried-Type, Beans, Succulent (Lima), Beans, Succulent (Snap), Beets (Greens),Brassica (Head And Stem) Vegetables, Buckwheat, Canola\Rape, Carrot (Including Tops), Cereal Grains, Clover, Cole Crops, Clover, Cole Crops, Corn, (Pop, Sweet, Silage, Filed), Cotton, Cowpea, Blackeyed Pea, Sitao Cowpea, Cucurbit Vegetables, Dill, Fruiting Vegetables, Garbanzos (Including Chick Peas), Golf Course Turf, Grass Forage/Fodder/Hay, Leafy Vegetables, Lentils, Lespedeza,	(4 fl oz/CWT) (11.5 % ai)	0.43	76	43	19

Use	Product application rate (fl oz/CWT) and % ai	Available ai (mg ai/ft^2)	Nagy Dose-Based EECs (mg/kg-bw/day)		
			Small (20 g)	Medium (100 g)	Large (1000 g)
Lupine(Grain), Oats , Nongrass Forage/Fodder/Straw/Hay, Oats, Onion, Ornamental And/Or Shade Trees, Ornamental Lawns And Turf, Peanuts, Peas, Residential Lawns, Rice, Root And Tuber Vegetables, Rye, Small Grains, Small Seeded Legumes, Soybeans, Spinach, Sugar Beet, Trefoil, Triticale, Vetch, Wheat					
Corn, Sweet, Golf Course Turf, Ornamental Lawns And Turf, Peas, Residential Lawns, Sunflower,	(8 fl oz/CWT) (11.5 % ai)	0.19	151	86	39
Corn (Unspecified), Sorghum	(14.1 fl oz/CWT) (11.5 % ai)	0.37	267.07	152.29	68.18
Proso Millet	(17.8 fl oz/CWT) (28.35% ai)	1.03	831	474	212
Mefenoxam					
Barley, triticale, wheat	(4 fl oz /CWT) (1.93% ai)	--	--	--	--
Oilseed Group 20	(0.32 fl oz /CWT) (33.3% ai)	0.01	18	10	4
Corn (sweet)	(5 fl oz /CWT) (1.93% ai)	--	--	--	--
Cotton	(5.8 fl oz /CWT) (1.93% ai)	--	--	--	--
Legumes	(5 fl oz /CWT) (1.1% ai)	--	--	--	--
Soybeans	(4.23 fl oz/CWT) (4.8% ai)	0.23	33	19	9

Mammalian Estimated Exposure Concentrations (EECs) from Seed Treatment Uses

Use	Product application rate (fl oz/CWT) and % ai	Available ai (mg ai/ft^2)	Nagy Dose-Based EECs (mg/kg-bw/day)		
			Small (20 g)	Medium (100 g)	Large (1000 g)
Metalaxyl					

Use	Product application rate (fl oz/CWT) and % ai	Available ai (mg ai/ft^2)	Nagy Dose-Based EECs (mg/kg-bw/day)		
			Small (20 g)	Medium (100 g)	Large (1000 g)
Ornamental grasses	(3.4 fl oz/CWT) (0.82 % ai)	0.00	3.84	2.66	0.62
Flax	(4.6 fl oz/CWT) (1.26 % ai)	--	--	--	--
Cucumber, Mustard, Okra, Clary Sage, Beets (Unspecified), Onions (Green)	(0.75 fl oz/CWT) (28.35 % ai)	--	--	--	--
Brassica (Cole) Leafy Vegetables	(1.5 fl oz/CWT) (28.35 % ai)	--	--	--	--
Barley, Beans, Beans, Dried-Type, Beans, Succulent (Lima), Beans, Succulent (Snap), Beets (Greens),Brassica (Head And Stem) Vegetables, Buckwheat, Canola\Rape, Carrot (Including Tops), Cereal Grains, Clover, Cole Crops, Clover, Cole Crops, Corn, (Pop, Sweet, Silage, Filed), Cotton, Cowpea, Blackeyed Pea, Sitao Cowpea, Cucurbit Vegetables, Dill, Fruiting Vegetables, Garbanzos (Including Chick Peas), Golf Course Turf, Grass Forage/Fodder/Hay, Leafy Vegetables, Lentils, Lespedeza, Lupine(Grain), Oats , Nongrass Forage/Fodder/Straw/Hay, Oats, Onion, Ornamental And/Or Shade Trees, Ornamental Lawns And Turf, Peanuts, Peas, Residential Lawns, Rice, Root And Tuber Vegetables, Rye, Small Grains, Small Seeded Legumes, Soybeans, Spinach, Sugar Beet,	(4 fl oz/CWT) (11.5 % ai)	0.43	63	44	10

Use	Product application rate (fl oz/CWT) and % ai	Available ai (mg ai/ft^2)	Nagy Dose-Based EECs (mg/kg-bw/day)		
			Small (20 g)	Medium (100 g)	Large (1000 g)
Trefoil, Triticale, Vetch, Wheat					
Corn, Sweet, Golf Course Turf, Ornamental Lawns And Turf, Peas, Residential Lawns, Sunflower,	(8 fl oz/CWT) (11.5 % ai)	0.21	127	88	20
Corn (Unspecified), Sorghum	(14.1 fl oz/CWT) (11.5 % ai)	0.33	267	86	36
Proso Millet	(17.8 fl oz/CWT) (28.35% ai)	1.03	696	481	112
Mefenoxam					
Barley, triticale, wheat	(4 fl oz /CWT) (1.93% ai)	--	--	--	--
Oilseed Group 20	(0.32 fl oz /CWT) (33.3% ai)	0.01	14.69	10.15	2.35
Corn (sweet)	(5 fl oz /CWT) (1.93% ai)	--	--	--	--
Cotton	(5.8 fl oz /CWT) (1.93% ai)	--	--	--	--
Legumes	(5 fl oz /CWT) (1.1% ai)	--	--	--	--
Soybeans	(4.23 fl oz/CWT) (4.8% ai)	0.23	28	19	4

Dose-based EECs (mg/kg bw) as Food Residues for Birds, Reptiles, and Terrestrial-Phase Amphibians from Labeled Uses of Metalaxyl and Mefenoxam (T-REX v. 1.5.2; June 6, 2013).

Primary Feeding Strategy →	Herbivores and Omnivores												Insectivores			Granivores		
Animal Size →	Small				Med				Large				Small	Med	Large	Small	Med	Large
Dietary Items → / Use(s) ↓	Short Grass	Tall Grass	Broad-leaf Plants	Fruits, pods, seeds, *etc.*	Short Grass	Tall Grass	Broadleaf Plants	Fruits, pods, seeds, *etc.*	Short Grass	Tall Grass	Broadleaf Plants	Fruits, pods, seeds, *etc.*	Arthropods			Seeds, grains, *etc.*		
Metalaxyl																		
Hops	319	146	179	20	182	83	102	11	81	37	46	5	125	72	32	4.4	2.5	1.1
Fruiting Vegetables, Strawberry	608	279	342	38	347	159	195	22	155	71	87	10	238	136	61	8	5	2.2
Cranberry	1147	526	645	72	654	300	368	41	293	134	165	18	449	256	115	16	9	4

Primary Feeding Strategy →	**Herbivores and Omnivores**												**Insectivores**			**Granivores**		
Animal Size →	Small				Med				Large				Small	Med	Large	Small	Med	Large
Dietary Items →	**Short Grass**	**Tall Grass**	**Broad-leaf Plants**	**Fruits, pods, seeds, *etc.***	**Short Grass**	**Tall Grass**	**Broadleaf Plants**	**Fruits, pods, seeds, *etc.***	**Short Grass**	**Tall Grass**	**Broadleaf Plants**	**Fruits, pods, seeds, *etc.***	**Arthropods**			**Seeds, grains, *etc*.**		
Use(s) ↓																		
Cole Crops, Cucurbit Vegetables, Leafy Vegetables, Lettuce	547	251	308	34	312	143	175	19	140	64	79	9	214	122	55	8	4	1.9
Eggplant, Pepper, Tomato	937	429	527	59	534	245	301	33	239	110	135	15	367	209	94	13	7.4	3.3
Golf Course Turf, Ornamental Lawns And Turf, Ornamental Sod Farm (Turf), Recreation Area Lawns	1641	752	923	103	936	429	527	59	419	192	236	26	643	367	164	23	13	6
Papaya	1730	793	973	108	986	452	555	62	442	202	248	28	677	386	173	24	14	6
Citrus (Trees)	1308	600	736	82	746	342	420	47	334	153	188	21	512	292	130	18	10	5
Avocado, Deciduous Fruit Trees (Unspecified), Stone Fruits, Tree Nuts	1340	614	754	84	765	350	430	48	342	157	193	21	525	299	134	19	11	5
Citrus (Nursery Stock)	3257	1493	1832	204	1857	851	1145	116	832	381	467	52	1276	727	326	45	26	12
Mefenoxam																		
Broccoli, Chinese Broccoli, Brussels Sprouts, Cabbage, Chinese Cabbage, Cauliflower	62	29	35	4	36	16	20	2	16	7	9	1	24	14	6	0.87	0.49	0.22
Bulb Vegetables	16	8	9	1	9	4	5	1	4	2	2	0.2	6	4	2	0.2	0.1	0.0
Beans (succulent, snap), Caneberries	51	23	29	3	29	13	16	2	13	6	7	1	20	11	5	1	0.4	0.1
Garlic	105	48	59	7	60	28	34	4	27	12	15	2	41	24	11	1	1	0.3
Pepper, Radish	90	41	51	6	51	24	29	3	23	11	13	1	35	20	9	1	1	0.3

Primary Feeding Strategy →	**Herbivores and Omnivores**												**Insectivores**			**Granivores**		
Animal Size →	Small				Med				Large				Small	Med	Large	Small	Med	Large
Dietary Items →	**Short Grass**	**Tall Grass**	**Broad-leaf Plants**	**Fruits, pods, seeds, *etc.***	**Short Grass**	**Tall Grass**	**Broadleaf Plants**	**Fruits, pods, seeds, *etc.***	**Short Grass**	**Tall Grass**	**Broadleaf Plants**	**Fruits, pods, seeds, *etc.***	**Arthropods**			**Seeds, grains, *etc*.**		
Use(s) ↓																		
Potato	48	22	27	3	27	13	15	2	12	6	7	1	19	11	5	1	0.3	0.1
Leek, Shallot	75	34	42	5	43	20	24	3	19	9	11	1	29	17	7	1	1	0.2
Melons, Pumpkin, Squash, Cucumber	112	52	63	7	64	29	36	4	29	13	16	2	44	25	11	2	1	0.4
Hops	68	31	38	4	39	18	22	2	17	8	10	1	27	15	7	0.95	0.54	0.24
Kiwi	202	93	114	13	116	53	65	7	52	24	29	3	79	45	20	3	2	0.7
Ginseng	210	96	118	13	120	55	67	8	54	25	30	3	82	47	21	3	2	1
Legume Vegetables	136	63	77	9	78	36	44	5	35	16	20	2	54	31	14	2	1	0.4
Fruiting Vegetables Strawberry	359	165	202	22	205	94	115	13	92	42	52	6	141	80	36	5	3	1
Turf	489	224	275	31	279	128	157	17	125	57	70	8	191	109	49	7	4	2
Cranberry	632	290	356	40	361	165	203	23	161	74	91	10	248	141	63	9	5	2
Carrots, Cucurbit Vegetables, Leafy Vegetables, Cole Crops, Spinach	273	125	154	17	156	71	88	10	70	32	39	4	107	61	27	4	2	1
Herbs, Tomato	511	234	288	32	292	134	164	18	131	60	73	8	200	114	51	7	4	2
Subtropical fruit	767	352	431	48	437	200	246	27	196	90	110	12	300	171	77	11	6	3
Tobacco	410	187	231	26	234	107	132	15	105	48	59	7	161	92	41	6	3	1
Blueberry, Bush Berries, Raspberry	925	424	521	58	528	242	297	33	236	108	133	14	362	207	93	13	7	3
Orchards (Unspecified), Stone Fruits, Tree Nuts, Avocado	764	350	430	48	436	200	245	27	195	89	110	12	299	171	76	11	6.0	3

Primary Feeding Strategy →	Herbivores and Omnivores												Insectivores			Granivores		
Animal Size →	Small				Med				Large				Small	Med	Large	Small	Med	Large
Dietary Items → / Use(s) ↓	Short Grass	Tall Grass	Broad-leaf Plants	Fruits, pods, seeds, *etc.*	Short Grass	Tall Grass	Broadleaf Plants	Fruits, pods, seeds, *etc.*	Short Grass	Tall Grass	Broadleaf Plants	Fruits, pods, seeds, *etc.*	Arthropods			Seeds, grains, *etc.*		
Citrus, Deciduous Fruit Trees (Unspecified)	654	300	368	41	373	171	210	23	167	77	94	10	256	146	65	9	5	2

Table 3.13. Dose-based EECs (mg/kg bw) as Food Residues for Mammals from Labeled Uses of Metalaxyl and Mefenoxam (T-REX v. 1.5.2; June 6, 2013).

Primary Feeding Strategy →	Herbivores and Omnivores												Insectivores			Granivores		
Animal Size →	Small				Med				Large				Small	Med	Large	Small	Med	Large
Dietary Items → / Use(s) ↓	Short Grass	Tall Grass	Broad-leaf Plants	Fruits, pods, seeds, *etc.*	Short Grass	Tall Grass	Broadleaf Plants	Fruits, pods, seeds, *etc.*	Short Grass	Tall Grass	Broadleaf Plants	Fruits, pods, seeds, *etc.*	Arthropods			Seeds, grains, *etc.*		
Metalaxyl																		
Hops	267	122	150	16.7	184	85	104	11.5	42.8	19.6	24.1	2.7	105	72.2	16.8	3.71	2.56	0.59
Fruiting Vegetables, Strawberry	509	233	286	32	352	161	198	22	82	37	46	5	199	138	32	7	5	1.1
Cranberry	961	440	540	60	664	304	373	41	154	71	87	10	376	260	60	13	9	2.1
Cole Crops, Cucurbit Vegetables, Leafy Vegetables, Lettuce	458	210	257	29	316	145	178	20	73	34	41	5	179	124	29	6	4	1
Eggplant, Pepper, Tomato	784	360	441	49	542	249	305	34	126	58	71	8	307	212	49	11	7.5	2
Golf Course Turf, Ornamental Lawns And Turf, Ornamental Sod Farm	1374	630	773	86	950	435	534	59	220	101	124	14	538	372	86	19	13	3

Primary Feeding Strategy →	Herbivores and Omnivores												Insectivores			Granivores		
Animal Size →	Small				Med				Large				Small	Med	Large	Small	Med	Large
Dietary Items →	Short Grass	Tall Grass	Broad-leaf Plants	Fruits, pods, seeds, *etc.*	Short Grass	Tall Grass	Broadleaf Plants	Fruits, pods, seeds, *etc.*	Short Grass	Tall Grass	Broadleaf Plants	Fruits, pods, seeds, *etc.*	Arthropods			Seeds, grains, *etc.*		
Use(s) ↓																		
(Turf), Recreation Area Lawns																		
Papaya	1448	664	815	91	1001	459	563	63	232	106	131	15	567	392	91	20	14	3
Citrus (Trees)	1095	502	616	68	757	347	426	47	175	80	99	11	429	296	69	15	11	2
Avocado, Deciduous Fruit Trees (Unspecified), Stone Fruits, Tree Nuts	1123	515	631	70	776	356	436	49	180	82	101	11	440	304	70	16	11	3
Citrus (Nursery Stock)	3257	1493	1832	204	1857	851	1045	116	832	381	468	52	1276	727	326	45	26	12
Mefenoxam																		
Broccoli, Chinese Broccoli, Brussels Sprouts, Cabbage, Chinese Cabbage, Cauliflower	52	24	29	3	36	17	20	2	8	4	5	0.52	20	14	3	0.73	0.50	0.12
Bulb Vegetables	14	6	8	1	9	4	5	1	2	1	1	0.1	5	3	1	0	00	0
Beans (succulent, snap), Caneberries	43	20	24	3	30	14	17	2	7	3	4	0.4	17	12	3	0.5	0.4	0.1
Garlic	88	41	50	6	61	28	34	4	14	6	8	1	35	24	6	1	1	0.2
Pepper, Radish	75	34	42	4	52	23	29	3	12	6	7	1	29	20	5	1	1	0.1
Potato	40	18	23	3	28	13	16	2	6	3	4	0.4	16	11	3	0.5	0.3	0.1
Leek, Shallot	63	29	35	4	43	20	24	3	10	5	6	1	25	17	4	1	1	0.1
Melons, Pumpkin, Squash, Cucumber	94	43	53	6	65	30	37	4	15	7	9	1	37	25	6	1	1	0.2
Hops	57	26	32	4	40	18	22	2	9	4	5	1	22	15	4	1	1	0.1
Kiwi	170	78	95	11	117	54	66	7	27	12	15	2	66	46	11	2	2	0.3
Ginseng	176	81	99	11	122	56	68	8	28	13	16	2	69	48	11	2	2	0.3

Primary Feeding Strategy →	Herbivores and Omnivores												Insectivores			Granivores		
Animal Size →	Small				Med				Large				Small	Med	Large	Small	Med	Large
Dietary Items →	Short Grass	Tall Grass	Broad-leaf Plants	Fruits, pods, seeds, *etc.*	Short Grass	Tall Grass	Broadleaf Plants	Fruits, pods, seeds, *etc.*	Short Grass	Tall Grass	Broadleaf Plants	Fruits, pods, seeds, *etc.*	Arthropods			Seeds, grains, *etc*.		
Use(s) ↓																		
Legume Vegetables	114	52	64	7	79	36	44	5	18	8	10	1	45	31	7	2	1	0.2
Fruiting Vegetables Strawberry	301	138	169	19	208	95	117	13	48	22	27	3	118	81	19	4	3	1
Turf	409	187	230	26	283	130	159	18	66	30	37	4	160	111	26	6	4	1
Cranberry	529	242	298	33	366	168	206	23	85	39	48	5	2070	143	33	7	5	1
Carrots, Cucurbit Vegetables, Leafy Vegetables, Cole Crops, Spinach	229	104	129	14	158	72	89	10	37	17	21	2	90	62	14	3	2	1
Herbs, Tomato	428	196	241	27	296	136	166	18	69	31	39	4	168	116	27	6	4	1
Subtropical fruit	642	294	361	40	444	203	250	28	103	47	58	6	251	174	40	9	6	1
Tobacco	343	157	193	21	237	109	133	15	55	25	31	3	134	93	22	4	2	0.8
Raspberry, Blueberry, Bush Berries	775	355	436	48	232	245	301	33	124	57	70	8	303	210	49	11	7	2
Orchards (Unspecified), Stone Fruits, Tree Nuts, Avocado	640	293	360	40	442	203	249	28	103	47	58	6	251	173	40	9	6	1
Citrus, Deciduous Fruit Trees (Unspecified)	550	251	308	34	378	173	213	24	88	40	49	5	214	148	34	8	5	1

Dietary-based EECs (mg/kg diet) as Food Residues for Birds, Reptiles, Terrestrial-phase Amphibians, and Mammals from Labeled Uses of Metalaxyl and Mefenoxam (T-REX v. 1.5.2; June 6, 2013).

Primary Feeding Strategy →	Herbivores, Omnivores, and Granivores				Insectivores
Dietary Items → / Use(s) ↓	Short Grass	Tall Grass	Broad-leaf Plants	Fruits, pods, seeds, *etc.*	Arthropods
Metalaxyl					
Hops	280	128	157	17.5	109
Fruiting Vegetables, Strawberry	534	245	300	33	209
Cranberry	1008	462	567	63	395
Cole Crops, Cucurbit Vegetables, Leafy Vegetables, Lettuce	480	220	270	30	188
Eggplant, Pepper, Tomato	823	377	463	51	322
Golf Course Turf, Ornamental Lawns And Turf, Ornamental Sod Farm (Turf), Recreation Area Lawns	1441	661	811	90	564
Papaya	1519	696	854	95	595
Citrus (Trees)	1149	526	646	72	450
Avocado, Deciduous Fruit Trees (Unspecified) Stone Fruits, Tree Nuts	1177	540	662	74	461
Citrus (Nursery stock)	2860	1311	1609	179	1120
Mefenoxam					
Broccoli, Chinese Broccoli, Brussels Sprouts, Cabbage, Chinese Cabbage, Cauliflower	55	25	31	3	21
Bulb Vegetables	14	7	8	1	6
Beans (succulent, snap), Caneberries	45	21	25	3	18
Garlic	93	42	52	6	36
Pepper, Radish	79	36	44	5	31
Potato	42	19	24	3	17
Leek, Shallot	66	30	37	4	26
Melons, Pumpkin, Squash, Cucumber	99	45	56	6	39

Primary Feeding Strategy →	Herbivores, Omnivores, and Granivores				Insectivores
Dietary Items → / Use(s) ↓	Short Grass	Tall Grass	Broad-leaf Plants	Fruits, pods, seeds, *etc.*	Arthropods
Hops	60	28	34	4	24
Kiwi	178	82	100	11	70
Ginseng	185	85	104	12	72
Legume Vegetables	120	55	68	8	47
Fruiting Vegetables, Strawberry	315	145	177	20	124
Turf	429	197	241	27	168
Cranberry	555	254	312	35	217
Carrots, Cucurbit Vegetables, Leafy Vegetables, Cole Crops, Spinach	240	110	135	15	94
Herbs, Tomato	449	206	253	28	176
Subtropical fruit	673	309	379	42	264
Tobacco	360	165	203	23	141
Blueberry, Bush Berries, Raspberry	813	372	457	51	318
Orchards (Unspecified), Stone Fruits, Tree Nuts, Avocado	671	307	377	42	263
Citrus, Deciduous Fruit Trees (Unspecified)	574	263	323	36	225

Calculated EECs for Terrestrial and Semi-Aquatic Plants near Metalaxyl and Mefenoxam Terrestrial Uses Area

Crop	Single Max. Application Rate (lbs ai/A)	Application Type	Spray Drift Only	Runoff and Spray Drift (Dry Areas)	Runoff and Spray Drift (Semi-Aquatic Areas)
Metalaxyl					
Hops	0.5	Ground	0.025	0.05	0.275
Fruiting Vegetables, Strawberry	1	Aerial	0.05	0.1	0.55
		Ground	0.01	0.06	0.51
Cranberry	1.8	Ground	0.018	0.108	0.918

Crop	Single Max. Application Rate (lbs ai/A)	Application Type	Spray Drift Only	Runoff and Spray Drift (Dry Areas)	Runoff and Spray Drift (Semi-Aquatic Areas)
Cole Crops, Cucurbit Vegetables, Leafy Vegetables, Lettuce, Root And Tuber Vegetables, Eggplant, Pepper, Tomato, Spinach	2	Ground	0.02	0.12	1.02
Golf Course Turf, Ornamental Lawns And Turf, Ornamental Sod Farm (Turf), Recreation Area Lawns	2.7	Ground	0.027	0.162	1.377
Papaya	3.6	Ground	0.036	0.216	1.836
Citrus (Trees)	4.0	Aerial	0.20	0.40	2.20
		Ground	0.04	0.24	2.04
Avocado, Deciduous Fruit Trees (Unspecified), Stone Fruits, Tree Nuts	4.1	Aerial	0.205	0.41	2.255
		Ground	0.041	0.246	2.091
Citrus (Nursery stock	10.2	Ground	0.102	0.612	5.202
Mefenoxam					
Broccoli, Chinese Broccoli, Brussels Sprouts, Cabbage, Chinese Cabbage, Cauliflower	0.062494	Aerial	0.00312	0.00624	0.0343
		Ground	0.0006	0.0036	0.0306
Bulb Vegetables	0.065528	Ground	0.0006	0.0036	0.0306
Garlic	0.1	Aerial	0.0005	0.001	0.0055
Beans (succulent, snap), Caneberries, Garlic, Pepper, Radish, Potato		Ground	0.0001	0.0006	0.0051
Leek, Shallot	0.104	Aerial	0.0052	0.0104	0.0572
		Ground	0.001	0.006	0.053
Melons, Pumpkin, Squash, Cucumber	0.135	Aerial	0.0068	0.135	0.074
		Ground	0.0014	0.008	0.0689
Hops	0.25	Ground	0.003	0.015	0.1275
Kiwi	0.35	Ground	0.004	0.021	0.1785
Ginseng	0.38	Ground	0.004	0.022	0.194
Legume Vegetables, Fruiting Vegetables	0.5	Aerial	0.025	0.05	0.275
Legume Vegetables, Fruiting Vegetables, Strawberry		Ground	0.005	0.03	0.255

Crop	Single Max. Application Rate (lbs ai/A)	Application Type	Spray Drift Only	Runoff and Spray Drift (Dry Areas)	Runoff and Spray Drift (Semi-Aquatic Areas)
Turf	0.68	Ground	0.007	0.040	0.347
Cranberry	0.88	Ground	0.009	0.053	0.449
Carrots, Cucurbit Vegetables, Leafy Vegetables, Cole Crops, Tomato	1	Aerial	0.05	0.1	0.55
Carrots, Cucurbit Vegetables, Leafy Vegetables, Cole Crops, Spinach, Herbs, Tomato		Ground	0.01	0.06	0.51
Subtropical fruit, Tobacco	1.5	Ground	0.015	0.09	0.765
Blueberry, Bush Berries,	1.81	Aerial	0.09	0.181	0.995
Blueberry, Bush Berries, Raspberry		Ground	0.02	0.11	0.923
Orchards (Unspecified), Stone Fruits, Tree Nuts, Avocado	2	Ground	0.02	0.12	1.02
Citrus, Deciduous Fruit Trees (Unspecified)	2	Ground	0.02	0.12	1.02
Citrus		Aerial	0.1	0.2	1.1

Appendix J. Ecotoxicity Data

Taxon	Test Material	% AI	Guideline; Study Type	Species	Toxicity Endpoints & Acute Toxicity Classification (If Applicable)	Source & Study Classification
Birds (surrogate for reptiles and terrestrial-phase amphibians)	Metalaxyl TGAI	(98.4)	850.2100 Acute oral: single dose, 14-day observation	Canary (*Serinus canaria*)	**LD_{50} (95% CI)=694 mg ai/kg-bw (594 to 810 mg ai/kg bw) NOAEC=173 mg ai/kg** **Moderately Toxic**	49311101 Acceptable
		(96.9)		Mallard Duck *(Anas platyrhynchos)*	LD50 (95% CI)=1466 mg/kg-bw (1128-1906 mg ai/kg-bw) NOAEC: Not reported Slightly Toxic	00077334/ 00234439 Acceptable
	Mefenoxam TGAI	(96.9)		Bobwhite quail *(Colinus virginianus)*	**LD_{50} (95% CI)=981 mg ai/kg-bw (720-1200 mg ai/kg-bw) NOAEL=259 mg ai/kg** **Moderately Toxic**	43875302 Acceptable
	Metalaxyl TGAI	(96.9)	850.2200 Sub-acute dietary: 5-day exposure; 3-day post-exposure observation	Mallard duck *(Anas platyrhynchos)*	8-Day LC_{50}>10,000 mg/kg-diet NOAEC=10,000 Practically Non-Toxic	00234439 Acceptable
		(96.5)		Bobwhite quail *(Colinus virginianus)*	8-Day LC50>10,000 mg/kg-diet NOAEC=10,000 Practically Non-Toxic	00234439 Acceptable
		(96.6)		Japanese Quail *(Coturnix japonica)*	8-Day LC_{50}>10,000 mg/kg-diet NOAEC=10,000 Practically Non-Toxic	00063988/ 00234439 Supplemental- Non guideline species

Taxon	Test Material	% AI	Guideline; Study Type	Species	Toxicity Endpoints & Acute Toxicity Classification (If Applicable)	Source & Study Classification
	Mefenoxam TGAI	(96.6)		Northern Bobwhite Quail (*Colinus virginianus*)	8-Day LC_{50} > 4830 mg/kg-diet NOAEC=4830 mg/kg-diet Slightly Toxic	43875303 Acceptable
	Metalaxyl TGAI	(90.1)	850.2300 Avian Reproduction Toxicity; 22 week dietary exposure	Northern Bobwhite Quail (*Colinus virginianus*)	NOAEC=300 mg/kg-diet LOAEC=900 mg/kg-diet 14-day survivors	43624602 Supplemental-qualitative: Controls only reported 62% successful hatching (see D230408)
		(88.7)			**NOAEC=900 mg/kg-diet** **LOAEC>900 mg/kg-diet** (No effects reported)	44755001 Supplemental-quantitative Maximum test concentration is below maximum field residue level- only valid for application rates below 3.75 lb ai/A
		(98.4)			NOAEC: <1421 mg ai/kg diet LOAEC: 1421 mg ai/kg diet (significant (8.2%) (p = 0.025) reduction in 14-d survivor weight at highest test concentration)	49115801 Supplemental-quantitative. There was a slight (8.2%) but significant (p = 0.025) reduction in 14-d survivor weight at the single treatment level relative to the negative control.

Taxon	Test Material	% AI	Guideline; Study Type	Species	Toxicity Endpoints & Acute Toxicity Classification (If Applicable)	Source & Study Classification
		(90.1)		Mallard Duck (*Anas platyrhynchos*)	NOAEC= 100 mg/kg- diet LOAEC=300 mg/kg-diet Endpoint Based on: Hatch success	43624603- Supplemental qualitative- Statistically significant increase in egg cracking and decrease in eggshell integrity at all test concentrations. Low hatching rate (56.9%) and 14 day survival (27%) in controls. (see D230408)
		(88.7)			NOAEC=900 mg/kg-diet LOAEC>900 mg/kg-diet (No effects reported)	44761701 Supplemental- quantitative Maximum test concentration is below maximum field residue level- only valid for application rates at or below 3.75 lb ai/A
		(98.4)			NOAEC=1421 mg/kg-diet LOAEC>1421 mg/kg-diet (No effects reported)	49115901 Acceptable- Limit test characterizes risk up to a maximum field application rate of 6lbs ai/acre.
	Mefenoxam TGAI	(97.8)		Northern Bobwhite Quail (*Colinus virginianus*)	**NOAEC=900 mg ai/kg-diet** **LOAEC>900 mg ai/kg-diet** No Effects observed at highest concentration	44720901 Acceptable- for use in risk assessment up to a maximum single application rate of 3.96 lbs ai/A or less

Taxon	Test Material	% AI	Guideline; Study Type	Species	Toxicity Endpoints & Acute Toxicity Classification (If Applicable)	Source & Study Classification
		(97.8)		Mallard Duck *(Anas platyrhynchos)*	NOAEC=900 mg ai/kg-diet LOAEC>900 mg ai/kg-diet No Effects Observed at highest concentration	44720902 Acceptable-for use in risk assessment up to a maximum single application rate of 3.96 lbs ai/A or less
Mammalian Toxicity	Metalaxyl TGAI	(96.6)	870.1100 Acute oral limit: single dose, 14-day observation	Rat (*Rattus norvegicus*)	**LD_{50}= 669 mg/kg** **NOAEL= 215 mg/kg** Slightly Toxic	00063990 Acceptable
	Mefenoxam TGAI	(96.6)			**LD_{50}=1269 mg/kg-bw** **NOAEL= 200 mg/kg-bw (based on mortality in females)** Slightly toxic	43800383 Acceptable
	Metalaxyl TGAI	(93.5)	870.3800 Chronic- 2 Generation reproduction study Metalaxyl TGAI (93.5)	Rat (*Rattus norvegicus*)	<u>Reproduction</u> **NOAEC=1250 mg/kg-diet** **LOAEC>1250 mg/kg-diet**	00071600 Acceptable
	Metalaxyl TGAI	(98.7)	870.1300 Acute Inhalation; 4-Hour Exposure, 14-day observation	Rat (*Rattus norvegicus*)	**LC_{50}>4.0 mg/L** **NOAEC=4.0 mg/L** No Effects Observed	49140708 Acceptable
	Mefenoxam TGAI	(97.1)			**LC_{50}>2.29 mg/L** **NOAEC=2.29 mg/L** No Effects Observed	43800385 Acceptable

Taxon	Test Material	% AI	Guideline; Study Type	Species	Toxicity Endpoints & Acute Toxicity Classification (If Applicable)	Source & Study Classification
Terrestrial invertebrates	Metalaxyl TGAI	(NR)	850.3020 Acute contact limit: single dose, 48-hour observation	Honey bee (*Apis mellifera*)	**LD_{50}>100 µg/bee** Practically Non-Toxic	40276701 Supplemental- Chemical purity not reported
	Mefenoxam TGAI	(96.6)		Honey bee (*Apis mellifera*)	**LD_{50}>25 µg ai/ bee** **NOAEC=25 µg ai/ bee** Practically Non-Toxic	43875308 Acceptable
Terrestrial Plants	Metalaxyl TEP	(44)	850.4100 Seedling Emergence and Growth of Non-Target Terrestrial Plants (Tier II)	**Monocots:** Corn, *Zea mays*; onion, *Allium cepa*; ryegrass, *Lolium perenne*; and wheat, *Triticum aestivum* **Dicots**: Cabbage, *Brassica oleracea*; lettuce, *Lactuca sativa;* oilseed rape, *Brassica napus;* soybean, *Glycine max*; sugarbeet, *Beta*	Most Sensitive Dicot: Lettuce (Based on survival) EC_{25}= 1.97 lbs ai/A NOAEC= 0.51 lbs ai/A (based on 21% reductions in survival and emergence in lettuce) Most sensitive Monocot: Onion (Based on dry weight) EC_{25}= 1.6 lbs ai/A NOAEC= 1.0 lbs ai/A (Based on 28-40% reduction in onion weight Dry Weight)	49024016 Acceptable

Taxon	Test Material	% AI	Guideline; Study Type	Species	Toxicity Endpoints & Acute Toxicity Classification (If Applicable)	Source & Study Classification
		(44)	850.4150 Vegetative Vigor: Non-Target Terrestrial Plants (Tier II)	*vulgaris*; and tomato, **Monocots** corn, *Zea mays*;onion, *Allium cepa*; ryegrass, *Lolium perenne*; and wheat, *Triticum aestivum* **Dicots** cabbage, *Brassica oleracea*; lettuce, *Lactuca sativa;* oilseed rape, *Brassica napus;* soybean, *Glycine max*; sugarbeet, *Beta vulgaris*; and tomato, *Lycopersicon esculentum*	Most sensitive dicot: Could not be determined due to a lack of toxicity EC_{25}/IC_{25}: >4.1 lb ai/A NOEC: 2.0 lb ai/A, soybean (Significant 9% inhibition in soybean height) Most sensitive Monocot: Could not be determined due to a lack of toxicity EC_{25}>4.0 lbs ai/A NOAEC: 4.0 lbs ai/A	49024015 Acceptable
	Mefenoxam TEP	(45.3)	850.4100 Seedling Emergence and Growth of Non-Target Terrestrial Plants (Tier II)	**Monocots** Corn, *Zea mays*; Onion, *Allium cepa*; Ryegrass, *Lolium perenne*; and Oat, *Avena sativa* **Dicots** Common bean, *Phaseolus vulgaris*; Cucumber, *Cucumis sativus*; Oilseed rape, *Brassica napus*;	Most sensitive Monocot: Could not be determined due to problems with onion endpoint Most sensitive Dicot: Could not be determined due to a lack of toxicity EC_{25}>3.06 lb ai/A NOAEC=3.06 lb ai/A	49049807 Supplemental- Higher than acceptable variance in height observed in onion.

Taxon	Test Material	% AI	Guideline; Study Type	Species	Toxicity Endpoints & Acute Toxicity Classification (If Applicable)	Source & Study Classification
		(45.3)	850.4150 Vegetative Vigor: Non-Target Terrestrial Plants (Tier II)	Radish, *Raphanus sativus*; Soybean, *Glycine max*; and Tomato, *Lycopersicon esculentum*	Most sensitive monocot: None EC_{25}>2.73 lb ai/A NOAEC= 2.73 lb ai/A Most sensitive dicot: Oilseed rape EC_{25}=2.76 lb ai/A NOAEC=0.76 lb ai/A (NOAEC based on reductions in dry weight)	49049808 Acceptable
Fish (surrogate for aquatic-phase amphibians)	Metalaxyl TGAI	(94.4)	850.1075; Acute: 96-hour exposure	Rainbow trout (*Oncorhynchus mykiss*)	**LC_{50} (95% CI)=130 mg ai/L (100-160 mg ai/L)** **NOAEC= 45 mg ai/L** Practically Nontoxic	00100447 Acceptable
		(95.1)			LC_{50} (95% CI)=132 mg ai/L (103-169 mg ai/L) NOAEC= 65 mg ai/L Practically Nontoxic	00071303 Acceptable
		(94.4)		Bluegill sunfish (*Lepomis macrochirus*)	LC_{50} (95% CI)=150 mg ai/L (130-170 mg ai/L) NOAEC=90 mg ai/L Practically Non-Toxic	00236854/ 00100446 Acceptable
		(95.1)			LC_{50}=139 mg ai/L NOAEC=108 mg ai/L Practically Non-Toxic	00071302 Supplemental- Lower than acceptable dissolved oxygen levels 8-4%

Taxon	Test Material	% AI	Guideline; Study Type	Species	Toxicity Endpoints & Acute Toxicity Classification (If Applicable)	Source & Study Classification
		(98.4)		Fathead Minnow (*Pimephales promelas*)	LC_{50}>123 mg/L NOAEC: 61 mg/L Practically Non-Toxic	49024002 In Review
		(98.4)		Sheepshead minnow (*Cyprinodon variegatus*)	LC_{50}>124 mg ai/L NOAEC: 64 mg ai/L Practically Non-Toxic	49024003 In Review
	Metalaxyl TEP	(27.9)		Bluegill sunfish (*Lepomis macrochirus*)	LC_{50} (95% CI)=7.53 mg ai/L (6.5-8.6 mg ai/L) NOAEC<6.97 mg ai/L Moderately Toxic	00071301 Acceptable
		(27.9)		Rainbow trout (*Oncorhynchus mykiss*)	LC_{50}(95% CI)=5.13 mg ai/L (6.5-8.6 mg ai/L) NOAEC<2.51 mg ai/L Moderately Toxic	00072396 Acceptable
		(44)		Bluegill sunfish (*Lepomis macrochirus*)	LC_{50}>125 mg ai/L NOAEC: 125 mg ai/L Practically non-toxic	49024001 In Review
		(44)		Rainbow trout (*Oncorhynchus mykiss*)	LC_{50}>123 mg/L NOAEC: 123 mg/L Practically Nontoxic	49024006 In Review

Taxon	Test Material	% AI	Guideline; Study Type	Species	Toxicity Endpoints & Acute Toxicity Classification (If Applicable)	Source & Study Classification
		(44)		Fathead Minnow (*Pimephales promelas*)	LC_{50}>125 mg/L NOAEC: 125 mg/L Practically Non-Toxic	49024001 In Review
		(44)		Sheepshead minnow (*Cyprinodon variegatus*)	LC_{50}>122 mg/L NOAEC: 122 mg/L Practically Non-Toxic	49024011 In Review
	Mefenoxam TGAI	(96.6)		Rainbow trout (*Oncorhynchus mykiss*)	LC_{50}>121 mg ai/L NOAEC= 72 mg ai/L Practically Non-Toxic	43875304 Acceptable
		(97.3)		Fathead Minnow (*Pimephales promelas*)	LC_{50}>110 mg ai/L NOAEC= 110 mg ai/L Practically Non-Toxic	49049803 Acceptable
		(97.3)		Sheepshead minnow (*Cyprinodon variegatus*)	**LC_{50}>95 mg ai/L** **NOAEC=95 mg ai/L** **Slightly Toxic**	49049805 Acceptable
	Mefenoxam TEP	(45.3)		Bluegill sunfish (*Lepomis macrochirus*)	LC_{50} (95% CI)=15.6 mg ai/L (12-20.2 mg ai/L) NOAEC= 11.3 mg ai/L Slightly Toxic	49049806 Acceptable

Taxon	Test Material	% AI	Guideline; Study Type	Species	Toxicity Endpoints & Acute Toxicity Classification (If Applicable)	Source & Study Classification
		(45.3)		Sheepshead minnow (*Cyprinodon variegatus*)	LC_{50} (95% CI)=14.4 mg ai/L (12-17.3 mg ai/L) NOAEC= 2.77 mg ai/L Slightly Toxic	49049804 Acceptable
	Metalaxyl TGAI	(90.1)	850.1400; Early Life-Stage Toxicity Test with a Freshwater Fish	Fathead Minnow (*Pimephales promelas*)	**NOAEC=9.1 mg ai/L** **LOAEC>9.1 mg ai/L** No effects observed	00071308 Acceptable
Aquatic Invertebrates	Metalaxyl TGAI	(94.4)	850.1010; Acute: 48-hour exposure	Water flea (*Daphnia magna*)	**LC_{50} (95% CI)= 28 mg ai/L (21-37 mg ai/L)** **NOAEC= 8.2 mg/L** **Slightly Toxic**	00100448 Acceptable
		(95.1)			LC_{50} (95% CI)= 121 mg ai/L (81-182 mg ai/L) NOAEC: 26 mg ai/L Practically Nontoxic	00071305 Acceptable
		(96.9)			LC_{50} (95% CI)=29.3 mg ai/L (22-33 mg ai/L) NOAEC= NR Slightly Toxic	00063986 Supplemental- Statistical test used combined data-temperature and other environmental conditions were outside of guideline requirements.
	Metalaxyl TEP	(27.9)			LC_{50} (95% CI) = 12.5 mg ai/L (2.8-4.4 mg ai/L) NOAEC= 6 mg ai/L Slightly Toxic	00071304 Acceptable

Taxon	Test Material	% AI	Guideline; Study Type	Species	Toxicity Endpoints & Acute Toxicity Classification (If Applicable)	Source & Study Classification
		(44)			EC_{50}>301 mg ai/L NOAEC: 11 mg ai/L Practically Nontoxic	49024004 In Review
	Mefenoxam TGAI	(95.2)			**LC_{50} (95% CI)= 53.8 mg ai/L (44-65 mg ai/L)** **NOAEC=10 mg ai/L** **Slightly Toxic**	49156001 Acceptable
		(96.6)			LC50>113 mg ai/L NOAEC=39 mg ai/L Slightly Toxic	43875305 Acceptable
	Metalaxyl TGAI	(90.1)	850.1300; Life-Cycle Toxicity Test with a Freshwater Aquatic Invertebrate; 21 day flow through	Water Flea (*Daphnia magna)*	**NOAEC=1.2 mg ai/L** **LOAEC=2.7 mg ai/L** **NOAEC based on: Mortality, Number of Offspring per Female**	00071307 Acceptable
	Metalaxyl TGAI	(98.4)	850.1025; Acute Toxicity Test with an Estuarine/Marine Mollusk; 96 hour flow through	Eastern Oyster (*Crassostrea virginica*)	**EC_{50} (95% CI)= 17.6 mg ai/L (12.4-25 mg ai/L)** **NOAEC= 5.4 mg ai/L** **Slightly Toxic**	49145101 Acceptable
		(96.1)			EC_{50} (95% CI)= 4.6 mg ai/L (2.8-11 mg ai/L) NOAEC= 1.4 mg ai/L Moderately Toxic	41288101 Supplemental- Shell deposition raw data were not provided and EC50 and NOAEC values could not be confirmed. study may only be used qualitatively

Taxon	Test Material	% AI	Guideline; Study Type	Species	Toxicity Endpoints & Acute Toxicity Classification (If Applicable)	Source & Study Classification
	Metalaxyl TEP	(25)			EC_{50} (95% CI)= 4.44 mg ai/L (4.09-4.86 mg ai/L) NOAEC= 1.80 mg ai/L Moderately Toxic	42378101 Acceptable
	Mefenoxam TGAI	(97.1)			**EC_{50} (95% CI) = 9.7 mg ai/L (8.2-11.0 mg ai/kg)** **NOAEC= 5.4 mg ai/L** **Moderately Toxic**	43875306 Acceptable
	Mefenoxam TEP	(45.3)			EC_{50} (95% CI)= 12.9 mg ai/L (12.1-13.8 mg ai/L) NOAEC= 3.6 mg ai/L Slightly Toxic	49049801 Supplemental- average shell growth (1.7mm) of control organisms was below the 2.0 minimum for new shell growth.
	Metalaxyl TGAI	(96.1)	850.1035; Acute Toxicity to an Estuarine/Marine Invertebrate; 96-hour static	Saltwater Mysid (*Americamysis bahia*)	LC_{50} (95% CI)= 25.7 mg ai/L (21-32 mg ai/L) NOAEC= 11 mg ai/L Slightly Toxic	41288103 Acceptable
	Metalaxyl TEP	(25)			LC_{50} (95% CI)= 1.5 mg ai/L (1.2-2.1 mg ai/L) NOAEC=0.59 mg ai/L Moderately Toxic	42337501 Acceptable
		Ridomil 2E (25)			LC_{50} (95% CI) =0.73 mg ai/L (0.64-0.86 mg ai/L) NOAEC=0.29 mg ai/L Highly Toxic	41288104 Supplemental- Uneven recovery across concentrations

Taxon	Test Material	% AI	Guideline; Study Type	Species	Toxicity Endpoints & Acute Toxicity Classification (If Applicable)	Source & Study Classification
		(44)			LC_{50}>122 mg/L NOAEC=19 mg/L Practically Nontoxic	49024010 In Review
	Mefenoxam TEP	Ridomil Gold SL (45.3)			LC_{50} (95% CI) =7.16 mg ai/L (6.2-8.2 mg ai/L) NOAEC= 3.1 mg ai/L Moderately Toxic	49049802 Acceptable
	Metalaxyl TGAI	(98.4)	850.1350; Life-Cycle Toxicity Test with an Estuarine/Marine Aquatic Invertebrate; 28-day flow through	Saltwater Mysid (*Americamysis bahia*)	**NOAEC= 0.74 mg ai/L** **LOAEC= 1.4 mg ai/L** **(NOAEC based on time to first brood, Number of offspring per female)** **<u>Endpoints affected</u>: Male length, reproduction (offspring per female), and time to first brood**	49116001 Acceptable
	Mefenoxam TGAI	(97.3)	850.1350; Life-Cycle Toxicity Test with an Estuarine/Marine Aquatic Invertebrate; 28-day flow through		**NOAEC= 9.7 mg ai/L** **LOAEC >9.7 mg ai/L** **Endpoints Affected: None**	49156002 Acceptable
Aquatic Plant Toxicity	Metalaxyl TGAI	(90)	850.4400; Aquatic Vascular Plant Toxicity Test; 7-day static	Duckweed (*Lemna gibba*)	**EC_{50}=85 mg ai/L** **NOAEC=56.5 mg ai/L** Most Sensitive Endpoints: Frond number, dry weight	00148448 Acceptable

Taxon	Test Material	% AI	Guideline; Study Type	Species	Toxicity Endpoints & Acute Toxicity Classification (If Applicable)	Source & Study Classification
	Mefenoxam TGAI	(98.2)			EC_{50} (95% CI)= 77 mg ai/L (69.5-86.5 mg ai/L) NOAEC<3.0 mg ai/L Most Sensitive Endpoint: Number of Fronds A NOAEC value was not determined in this study because a significant decrease in the number of fronds was observed at all concentrations.	43875307 Acceptable
	Metalaxyl TGAI	(90.0)	850.4500; Toxicity Test with the Freshwater Alga; 96-hour static	Green Algae (*Pseudokirchneriella subcapitata*)	**EC_{50}=140 mg/L** **NOAEC= 100 mg/L** **Endpoints Affected: Biomass**	00148448/ 00257606 Supplemental- Reported endpoints were for 14-day inhibition
	Metalaxyl TGAI	(98.4)			**EC_{50}=20.3 mg ai/L (17.3-23.8 mg ai/L) (mm)** **NOAEC=6.2 mg ai/L (mm)** **Most Sensitive Endpoint(s): Area Under the Growth Curve (AUC)**	49024012 Acceptable
	Metalaxyl TGAI	(98.4)	850.5400; Toxicity Test with the Freshwater diatom; 96-hour static	Freshwater Diatom (*Navicula pelliculosa*)	EC_{50}>99 mg ai/L NOAEC= 99 mg ai/L (Based on Cell Density, Growth Rate, Yield, and AUC)	49024007 In Review
	Mefenoxam TGAI	(97.3)			EC_{50} (95% CI) =93 mg ai/L (70.24 to 124.4 mg ai/L) NOAEC=44 mg ai/L (Endpoint based on Yield)	49049809 Acceptable

Taxon	Test Material	% AI	Guideline; Study Type	Species	Toxicity Endpoints & Acute Toxicity Classification (If Applicable)	Source & Study Classification
	Metalaxyl TGAI	(98.4)	850.4550; Toxicity Test with Cyanobacteria	Cyanobacteria (*Anabaena flos-aquae*)	EC_{50}>98 mg ai/L NOAEC 98 mg ai/L (Based on Cell Density, Growth Rate, AUC and Yield)	49049810 Acceptable
	Mefenoxam TGAI	(97.3)			EC_{50} (95% CI)= 110 mg ai/L (100.8-120 mg ai/L) NOAEC= 97 mg ai/L (Endpoint Based on yield)	49024005 In Review
	Metalaxyl TGAI	(98.4)	850.4500; Toxicity Test with the Marine Diatom	Marine Diatom (*Skeletonema costatum*)	EC_{50}>99 mg ai/L NOAEC 99 mg ai/L (Based on Cell Density, Growth Rate, Yield, and AUC)	49024008 In Review

Appendix K. Summary of Registered Uses for Metalaxyl and Mefenoxam

Uses	Application Timing	Application type	Maximum Number of applications / year (Crop Cycle)	Minimum Retreatment Interval (days)	Maximum rate / single application (lbs ai/A)	Maximum rate / year (lbs ai/A)	Registration Number
Agricultural Uses							
Seed Treatments							
Metalaxyl							
Ornamental Grasses	NA	ST	NA	NA	0.00002 lb/lb seed	NA	PA100001,TN090006 (2)
Flax	NA	ST	NA	NA	0.00004 lb/lb seed	NA	7969-371 (1)
Cucumber, Mustard, Okra, Clary Sage, Beets (Unspecified)	NA	ST	NA	NA	0.0001 lb/lb seed	NA	34704-942 (1), 42750-208 (1),
Onions (Green), Brassica (Cole) Leafy Vegetables	NA	ST	NA	NA	0.0002 lb/lb seed	NA	34704-1061,34704-942 (2), 42750-208,83529-36 (2), 2935-458 (1)
Barley, Beans, Beans, Dried-Type, Beans, Succulent (Lima), Beans, Succulent (Snap), Beets (Greens),Brassica (Head And Stem) Vegetables, Buckwheat, Canola\Rape, Carrot (Including Tops), Cereal Grains, Clover, Cole Crops, Clover, Cole Crops, Corn, (Pop, Sweet, Silage, Filed), Cotton, Cowpea, Blackeyed Pea, Sitao Cowpea, Cucurbit Vegetables, Dill, Fruiting Vegetables, Garbanzos (Including Chick Peas), Golf Course Turf, Grass Forage/Fodder/Hay, Leafy Vegetables, Lentils, Lespedeza, Lupine(Grain), Oats , Nongrass Forage/Fodder/Straw/Hay, Oats, Onion, Ornamental And/Or Shade Trees, Ornamental Lawns And Turf, Peanuts, Peas, Residential Lawns, Rice, Root And Tuber	NA	ST	NA	NA	0.0003 lb/lb seed	NA	34704-942 (1), 2935-458 (1), 2935-458,400-573,400-595,55146-110,55146-112,55146-122 (6), 1381-221,34704-933,55146-119 (3), 264-971,34704-942,42750-268 (3), 55146-112, 34704-942 (1), 2935-458 (1), 2935-458 (1), 34704-1061,34704-942 (2), 55146-117 (1), 34704-942 (1)

Uses	Application Timing	Application type	Maximum Number of applications / year (Crop Cycle)	Minimum Retreatment Interval (days)	Maximum rate / single application (lbs ai/A)	Maximum rate / year (lbs ai/A)	Registration Number
Vegetables, Rye, Small Grains, Small Seeded Legumes, Soybeans, Spinach, Sugar Beet, Trefoil, Triticale, Vetch, Wheat							
Corn, Sweet, Golf Course Turf, Ornamental Lawns And Turf, Peas, Residential Lawns, Sunflower,	NA	ST	NA	NA	0.0006 lb/lb seed	NA	34704-1061,34704-942 (2), 2935-458 (1), 42750-208,83529-36 (2), 70506-289 (1), 34704-1061
Peas	NA	ST	NA	NA	0.0008 lb/lb seed	NA	34704-942 (1), 55146-117 (1)
Corn (Unspecified), Sorghum	NA	ST	NA	NA	0.0011 lb/lb seed	NA	59639-191 (1), 34704-942 (1), 2935-458 (1), 264-1044 (1)
Proso Millet	NA	ST	NA	NA	0.0014 lb/lb seed	NA	34704-942 (1)
Mefenoxam							
Barley	NA	ST	NA	NA	.00005971 lbs/ lbs seed	NA	100-1141
Sweet Corn	NA	ST	NA	NA	.00007464 lbs ai/ lb seed	NA	100-1141
Cotton	NA	ST	NA	NA	.00008658 lbs ai/ lb seed	NA	100-1141, 100-1285
Legume Vegetables	NA	ST	NA	NA	.00003713 lbs ai/ lb seed	NA	100-1141
Soybeans	NA	ST	NA	NA	0.00015038 lbs ai/lb seed	NA	100-1450, 100-946
Triticale	NA	ST	NA	NA	.00005971/lb ai seed	NA	100-1141
Wheat	NA	ST	NA	NA	.00005971/lb ai seed	NA	100-1141
Foliar/broadcast application							
Metalaxyl							
Alfalfa	At Planting	A,G,B	NS	NS	0.508	NS	71532-5 (1), 70506-289 (1)

Uses	Application Timing	Application type	Maximum Number of applications / year (Crop Cycle)	Minimum Retreatment Interval (days)	Maximum rate / single application (lbs ai/A)	Maximum rate / year (lbs ai/A)	Registration Number
Almond, Apple, Blueberry	Post plant, pre bloom	A,G,B,D	NS	60	4.1	NS	71532-5 (1), 55146-109 (1), 70506-289 (1),
Asparagus	Post plant, pre-cutting, planting bed	A,G,B	NS	NS	1	NS	71532-5 (1), 55146-109 (1)
Avocado	Transplant	Ground soil injection, C	NS	90	0.92 (lb/tree)	12.2	71532-5 (1), 55146-109 (1)
Christmas Tree Plantations	Transplant, early spring, fall	C, SB	NS	NS	5	NS	55146-108,71532-24 (2),
Citrus	At Planting, as needed	A,G,SB,B,D	NS	90	4.1 (aerial) / 5.3 ground spray (or 10.4 for nurserystock)	12 (12.8 presumed for nursery stock)	71532-5 (1), 55146-109 (1), 55146-108,71532-24 (2), 70506-289 (1)
Clover	At planting	G,B	NS	NS	0.51	NS	71532-5 (1), 55146-109 (1),
Cole Crops	Pre plant, at planting	G,B	NS	NS	2	2	71532-5 (1), 55146-109 (1), ,71532-24 (2), 70506-289 (1)
Commercial/Industrial Lawns	Foliar, post plant	B,C	NS	14	2.7	NS	55146-108,71532-24 (2)
Conifers (Plantations/Nurseries)	Fall, seed bed, transplant, spring	B	NS	NS	5.5	12	71532-5 (1), 42750-250,55146-109 (2), 70506-289 (1)
Cranberry	Preharvent, post harvest, spring	B	3 (CC)	NS	1.8	5.34	55146-109 (1)
Cucurbit Vegetables	Preplant, at planting	B, SB	NS	NS	2.0	2.0	71532-5 (1),55146-109 (2), 70506-289 (1)
Deciduous Fruit Trees (Unspecified)	At planting	A, G, B, SB	NS	90	4.2	12.2	71532-5, 55146-108,71532-24, 55146-109, 70506-289

Uses	Application Timing	Application type	Maximum Number of applications / year (Crop Cycle)	Minimum Retreatment Interval (days)	Maximum rate / single application (lbs ai/A)	Maximum rate / year (lbs ai/A)	Registration Number
Eggplant	Preplant, at planting	A, G, SB	NS	17	2	3	71532-5, 55146-109 , 70506-289
Forest Trees (Softwoods, Conifers)	Early spring, fall	G, B, SB, C	NS	NS	5	NS	5146-108,71532-24
Fruiting Vegetables	At plant, preplant, emergence	A, G, SB,	NS	17	1	3.04	55146-109
Ginseng	Preplant, post plant	SD	NS	NS	1.5	NS	71532-5 (1), 55146-109 (1), 70506-289 (1)
Golf Course Turf	Foliar	G, B, C	3 application of 1.4 lbs ai/A	17	2.7	NS	55146-108 (1) , 71532-24 (1)
Grass Forage/Fodder/Hay	At planting	A, B	NS	NS	1	NS	71532-5 (1)
Hops	Pruning	G, B, SB	3	NS	0.5	NS	71532-5 (1), 55146-109 (1)
Leafy Vegetables	Preplant, at plant	S, B, SB	NS	NS	2	(2) NS	71532-5 (1), 55146-109 (1), 70506-289 (1)
Legume Vegetables	Preplant, at plant	G, B, SB	NS	NS	1	NS	71532-5 (1), 55146-109 (1), 70506-289 (1)
Lettuce	Preplant, at plant	G, B, SB	NS	NS	2	(2) NS	55146-109 (1),
Onion	Preplant, at plant	G, B, SB	NS	NS	1	NS	71532-5 (1), 55146-109 (1), 70506-289 (1)
Ornamental and/or Shade Trees	When needed	SD	NS	70	6.8	NS	55146-108,71532-24 (2), 70506-289 (1)
Ornamental Herbaceous Plants	Preplant, at plant	G, B, C, SB, SD	NS	42	3.4	NS	55146-108,71532-24 (2), 70506-289 (1)
Ornamental Lawns And Turf	Foliar	G, B, C	3 Applications Of 1.4 Lbs Ai/CC	14	2.7	NS	55146-108 (1), 71532-24 (1), 71532-5 (1), 42750-250,55146-109 (2)

Uses	Application Timing	Application type	Maximum Number of applications / year (Crop Cycle)	Minimum Retreatment Interval (days)	Maximum rate / single application (lbs ai/A)	Maximum rate / year (lbs ai/A)	Registration Number
Ornamental Nonflowering Plants	Transplant	SD	NS	NS	1.7	NS	70506-289 (1)
Ornamental Sod Farm (Turf)	foliar	G, B, C	3 Applications Of 1.4 Lbs Ai/CC	14	2.7	NS	55146-108 (1), 71532-24 (1), 42750-250 (1)
Ornamentals (Unspecified)	As needed	SD	NS	60	3.5	NS	71532-5 (1), 55146-108 (1), 71532-24 (1), 42750-250 (1)
Papaya	Transplant	B	2	14	3.6	NS	71532-5 (1), 55146-109 (1), 70506-289 (1)
Peanuts	At planting	C	NS	NS	1	NS	71532-5 (1), 55146-109 (1), 70506-289 (1)
Pepper	At planting, pre planting, pre emergence	A, G, B, SB	NS	17	2	3	71532-5 (1), 55146-109 (1), 70506-289 (1)
Pineapple	Foliar	C	NS	NS	1	NS	71532-5 (1), 55146-109 (1), 70506-289 (1)
Potato, White/Irish (Or Unspecified)	Preplant, at bloom	B, SD	NS	NS	2	NS	71532-5 (1), 55146-109 (1), 70506-289 (1)
Recreation Area Lawns	Post plant, foliar	C, SB	(3 applications of 1.4 lbs ai/A)	14	2.7	NS	55146-108 (1), 71532-24 (1)
Residential Lawns	Post plant, foliar	B, C	NS	14	2.7	NS	55146-108 (1)
Root And Tuber Vegetables	Preplant, at planting	B, SB	NS	NS	2	(2) NS	71532-5 (1), 55146-109 (1), 70506-289 (1)

Uses	Application Timing	Application type	Maximum Number of applications / year (Crop Cycle)	Minimum Retreatment Interval (days)	Maximum rate / single application (lbs ai/A)	Maximum rate / year (lbs ai/A)	Registration Number
Soybeans (Unspecified)	Preplant, at planting	A, G, SB	NS	NS	1.3	NS	71532-5 (1), 55146-109 (1), 70506-289 (1)
Spinach	Preplant, at planting	G, B, SB	NS	21	2	(2.8) NS	71532-5 (1), 55146-109 (1),
Stone Fruits	Post plant	A, G, SB	3	60	4.1	NS	71532-5 (1), 55146-109 (1), 70506-289 (1)
Strawberry	Foliar	G, B, SB	NS	30	1	3	71532-5 (1), 55146-109 (1),
Sugar Beet	Preplant, at planting	G, B, SB	NS	NS	2	NS	71532-5 (1), 55146-109 (1), 70506-289 (1)
Tobacco	Preplant	G, B, SB	NS	NS	3	NS	71532-5 (1), 55146-109 (1), 70506-289 (1)
Tomato	At Planting	A, G, B, SB	NS	NS	2	(3) NS	71532-5 (1), 55146-109 (1), 70506-289 (1)
Tree Nuts	At Planting	A, G, B, SB	NS	90	4.1	12.2	71532-5 (1), 55146-109 (1), 70506-289 (1), 55146-108
Trefoil	At Planting	A, G	NS	NS	0.5	NS	71532-5 (1), 55146-109 (1),
Walnut (English/Black)	As needed	A, G, B, SB	NS	60	4.1	NS	71532-5 (1), 55146-109 (1), 70506-289 (1)
Mefenoxam							
Alfalfa	Foliar, at planting	A,G,B,C	NS	NS	.25056563	NS	100-1145, 100-1202
Apple	Fall, early spring	A, G, B, C	NS	NS	4.00905	NS	100-1145, 100-1202
Artichoke	At planting	A, G,	NS	NS	1	NS	100-1145, 100-1202
Asparagus	Planting, pre harvest	A,G, C	NS	NS	.5013725	NS	100-1145, 100-1202

Uses	Application Timing	Application type	Maximum Number of applications / year (Crop Cycle)	Minimum Retreatment Interval (days)	Maximum rate / single application (lbs ai/A)	Maximum rate / year (lbs ai/A)	Registration Number
Avocado	Preharvest, post plant	C, SD	3 (3 CC)	90	2.00549	6	100-1145, 100-1202, 100-798
Basil	Seed bed	G	NS	NS	0.50655	2	AL110003, FL110012, MI120004. NE150003, PA150002, TX150004, VA150003
Beans (succulent, snap)	Foliar	G, C	2	7	0.1	0.2 CC	100-804
Blueberry	At Planting	A, G	NS	NS	1.804941	3.6 CC	100-1145
Broccoli, Chinese Broccoli	Foliar	A,G	NS	14	0.06249375	0.5	100-1221
Brussels Sprouts	Foliar	A, G	NS	14	.06249375	0.5 CC	100-1187
Bulb Vegetables	At planting	Furrow	1 CC	NS	.06552773	1 CC	100-1221
Bush Berries	At planting	A,G	2 CC	NS	1.804	3.6 CC	100-1145, 100-1202
Cabbage, Chinese Cabbage	Foliar	A,G	NS	14	.06249375	0.5 CC	100-1221
Caneberries	Foliar	G, C	2 CC	7	0.1	0.2 CC	100-1221, 100-804
Carrots	Pre emergence, at planting, Foliar	A, G, C	NS	NS	1	1	100-1145, 100-1202
Cauliflower	Foliar	A, G	NS	14	.06249375	0.5 CC	100-1221
Citrus	At planting, established plantings	A, G, C	3	90	2	6 CC	100-1145, 100-1202
Clover	At Planting	A, G, C	NS	NS	0.25056563	NS	100-1145, 100-1202
Cole Crops	Preplant, at planting	A, B	NS	NS	1	1	100-1145
CONIFERS (PLANTATIONS/NURSERIES)	Seed bed, at transplant, Foliar	B, C	NS	NS	2.5	NS	100-794, 100-796
Cotton	At planting	G	NS	NS	0.12220955	NS	100-798, 100-1141, 100-1145,

Uses	Application Timing	Application type	Maximum Number of applications / year (Crop Cycle)	Minimum Retreatment Interval (days)	Maximum rate / single application (lbs ai/A)	Maximum rate / year (lbs ai/A)	Registration Number
							100-1187, 100-1202, 100-1285, 100-1286
Cranberry	Preharvest, fall, spring	B, C	3 CC	NS	0.875	2.65 CC	100-1145, 100-798, 100-1202
Cucumber	Foliar	A, G	NS	10	0.13540313	0.5 CC	100-1221
Cucurbit Vegetables	At planting, preplant	A, G, C	NS	NS	1	1 CC	100-1145, 100-1187, 100-1202
DECIDUOUS FRUIT TREES (UNSPECIFIED)	At planting, Foliar	G, C	NS	90	2	6.0	100-794, 100-796,
FRUITING VEGETABLES	Preplanting, at planting	A, G	NS	NS	0.5	1.5	100-1145, 100-1202
Garlic	Foliar	A, G	NS	7	0.10	0.5 CC	100-1221
Ginseng	Spring	G	NS	30	0.375	1.5	100-1145, 100-1202, 100-798
Grapes	Foliar	G, C	NS	NS	1.8	NS	100-1202, 100-804
GRASS FORAGE/FODDER/HAY	At planting	G, A, C	NS	NS	.5013725	NS	100-1145, 100-1202
Herbs	Planting, pre plant, post plant	G, B	NS	NS	1	2 CC	100-1145, 100-1202
Hops	Foliar	SD	NS	NS	0.25	0.25	100-1145, 100-1202
Kiwi	Fall, Spring	SD	(5)	30	0.35	1.7539	100-1145, 100-1202
Leafy Vegetables	Preplant, at planting	A, G, B	NS	NS	1	1	100-1145, 100-1202
Leek	Foliar	A, G, B	NS	NS	0.104	0.3	100-1221
Legume Vegetables	Foliar	A, G, C	NS	NS	0.5	0.5	100-1145, 100-804, 100-946
Lettuce	Preplanting, Foliar	A, G, C	(1)	NS	1	NS	100-1202
Melons	Foliar	A, G, B	NS	10	0.135	0.5	100-1221
Onion (bulb and Green)	At planting, Foliar	A, G, B	NS	7	0.5	1	100-1145, 100-1202, 100-1221

Uses	Application Timing	Application type	Maximum Number of applications / year (Crop Cycle)	Minimum Retreatment Interval (days)	Maximum rate / single application (lbs ai/A)	Maximum rate / year (lbs ai/A)	Registration Number
ORCHARDS (UNSPECIFIED)	Foliar, at planting	G	NS	60	2	6	100-798
Turf	Foliar	G	(3)	7	.68053136	NS	100-796
Ornamentals (Unspecified)	Preplant, post plant, post transplant	C, G, SD	NS	NS	NS	2	100-1393, 100-794, 100-796
Peanuts	At planting, post emergence	A, G	NS	NS	1.8	NS	100-1145, 100-1187, 100-1202, 100-798
Pepper	Foliar	G, C	4	NS	0.1	1.5	100-804
Pineapple	At planting, Foliar	Dip	NS	NS	0.50	NS	100-1145, 100-1202
Potato	At planting, Foliar	A,G	NS	14	0.1	0.188 CC	100-1145, 100-1202, 100-1221, 100-1311, 100-804
Pumpkin	Foliar	A,G	NS	10	0.135	0.5 CC	100-1221
Radish	Foliar	A,G	(4)	14	0.1	NS	100-804
Raspberry	Foliar, post harvest	B, SB	(2)	NS	1.81	NS	100-1145, 100-798
Root and Tuber Vegetables	At planting	A,G	NS	NS	1.00	NS	100-1145, 100-1187
Shallot	Foliar	A,G	NS	NS	0.104	0.3 CC	100-1221
Soybeans	At planting	A,G	NS	NS	0.627	NS	100-1145, 100-1202, 100-798
Spinach	Preplant, At plant,	G	NS	NS	1	1	100-1145, 100-1202
Squash	Foliar	A,G	NS	10	0.135	0.5 CC	100-1221
Stone Fruits	Post Plant	G	3	60	2	6 CC	100-1145, 100-1202
Strawberry	Preharvest, post harvest	G, C	(3)	NS	0.5	1.5 CC	100-1145, 100-1202
Subtropical fruit	Foliar	G, C, SD	(2)	NS	1.5	3 CC	100-1145, 100-1202, 100-804
Sugar Beet	Pre plant, at planting	A,G	NS	NS	1	NS	100-1145, 100-1202

Uses	Application Timing	Application type	Maximum Number of applications / year (Crop Cycle)	Minimum Retreatment Interval (days)	Maximum rate / single application (lbs ai/A)	Maximum rate / year (lbs ai/A)	Registration Number
Tobacco	Preplant, Post plant	G	1	NS	1.5	1.5	100-1145, 100-1202
Tomato	Preplant, Post plant	A,G,C	NS	NS	1	1.5 CC	100-1145, 100-1202
Tree Nuts	Preplant, Post plant	G	3	60	2	6	100-1145, 100-1202, 100-794

A= Aerial, G=Ground, C= Chemigation, SB= Soil Band Treatment, B= Broadcast, SD= Soil Drench treatment

Appendix L. Provisional Cranberry Model Inputs and Equations

Application Inputs

App. rate (lbs/A)	Days pre-flood	App. rate at flood (lbs/A)
0.88		0.8800
0.88		0.8800
0.88	**45**	0.8360

Total residues per area at flood (lbs/A):		**2.5960**

Inputs

Parameter	Value	
Koc (L/kg)	**409**	MRID 43875309
If no Koc, enter Kd (L/kg)		
Aerobic Aquatic Metabolism $t_{1/2}$ (d)	**790**	MRID 47886101; MRID 42259802
Aerobic Soil Metabolism $t_{1/2}$ (d)	**5000**	90% confidence limit on the mean value of total toxic residue (TTR) values

Eco EECs

Holding Time	Peak	21-d Mean	60-d Mean	Annual Mean
Paddy	1652.84	1638.42	1610.79	1414.92
3-d Tail	1648.49	1634.12	1606.56	1411.21
21-d Tail	1622.66	1608.51	1581.38	1389.09

The Provisional Cranberry Model is a refinement of the Tier I Rice Model v1.0 (Equations 1 and 2), which is a simple equilibrium partitioning equation that calculates a single, screening-level concentration in rice paddy water and released tailwater based on a compound's application rate and soil mobility.

Equations 1-2: Tier I Rice Model v1.0 (USEPA, 2007b).

$$C_{w0} = \frac{10^2 m_{ai}'}{d_w + d_{sed}\left(\theta_{sed} + 10^{-3}\rho_b K_d\right)} \quad (1)$$

and, if appropriate:

$$K_d = 0.01 K_{OC} \quad (2)$$

where,

C_{w0} = initial water concentration [µg/L]
m_{ai}' = mass applied per unit area [kg/ha]

K_d = water-sediment partitioning coefficient [L/kg]
K_{OC} = organic carbon partitioning coefficient [L/kg]
d_w = water column depth = 0.10 m
d_{sed} = sediment depth = 0.01 m
θ_{sed} = porosity of sediment = 0.509
ρ_b = bulk density of sediment = 1300 kg/m^3

First, the Tier I Rice Model was provisionally modified (Equation 3) to include as inputs degradation rate constants in order to estimate single, screening-level concentrations in paddy water or tailwater at a given time after application.

Equation 3: Provisional Modified Rice Model (Jones, 2006).

$$C_w = \frac{m_{ai}' e^{-kt}}{0.00105 + 0.00013K_d} \quad (3)$$

where,

C_w = water concentration [µg/L]
t = interval since last application [d]
k = upper 90th percentile degradation rate constant [1/d]

Then, the Provisional Modified Rice Model water column depth was increased to a depth that is used to flood cranberry bogs (*i.e.*, 12 inches; **Cape Cod Cranberry Growers** Association, 2001**).**

i.e.,

d_w = water column depth = 0.305 m

In order to model degradation prior to the flood at harvest, the application rates for n number of pre-harvest applications were independently degraded over the interim until flooding and then summed (Equation 4).

Equation 4: Degradation in a Dry Bog.

$$m_{ai}' = \sum_{1}^{n} m_{ai}'_n \times e^{-k_2 t_n} \quad (4)$$

where,

m_{ai}' = mass per unit area at flood [kg/ha]
$m_{ai}'_n$ = mass applied per unit area on the nth application [kg/ha]
k_2 = upper 90th percentile degradation rate constant on dry bog [1/d]
t_n = interval from the nth application to harvest [d]
n = number of pre-harvest applications

These four equations and parameter sets constitute the Provisional Cranberry Model (Equations 1-4).

Equations 2, 4, and 5: Provisional Cranberry Model.

$$m_{ai}' = \sum_{1}^{n} m_{ai\ n}' \times e^{-k_2 t_n} \tag{4}$$

where,

m_{ai}' = mass per unit area at flood [kg/ha]
$m_{ai\ n}'$ = mass applied per unit area on the n^{th} application [kg/ha]
k_2 = upper 90^{th} percentile degradation rate constant on dry bog [1/d]
t_n = interval from the n^{th} application to harvest [d]
n = number of pre-harvest applications

followed by:

$$C_w = \frac{10^2 m_{ai}' e^{-kt}}{d_w + d_{sed}\left(\theta_{sed} + 10^{-3}\rho_b K_d\right)} \tag{5}$$

and, if appropriate:

$$K_d = 0.01 K_{OC} \tag{2}$$

where,

C_w = water concentration [µg/L]
t = interval since flood [d]
k = upper 90^{th} percentile degradation rate constant [1/d]
K_d = water-sediment partitioning coefficient [L/kg]
K_{OC} = organic carbon partitioning coefficient [L/kg]
d_w = water column depth = 0.305 m
d_{sed} = sediment depth = 0.01 m
θ_{sed} = porosity of sediment = 0.509
ρ_b = bulk density of sediment = 1300 kg/m^3